INTER AVIA

Review of World Aviation

In this Issue:

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Decisive Years in Aircraft Industry — Radar in Australia

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Trans-Atlantic Flight — Economic Aspects of Aeronautics

Marshall/Katz: Television Guided Missiles

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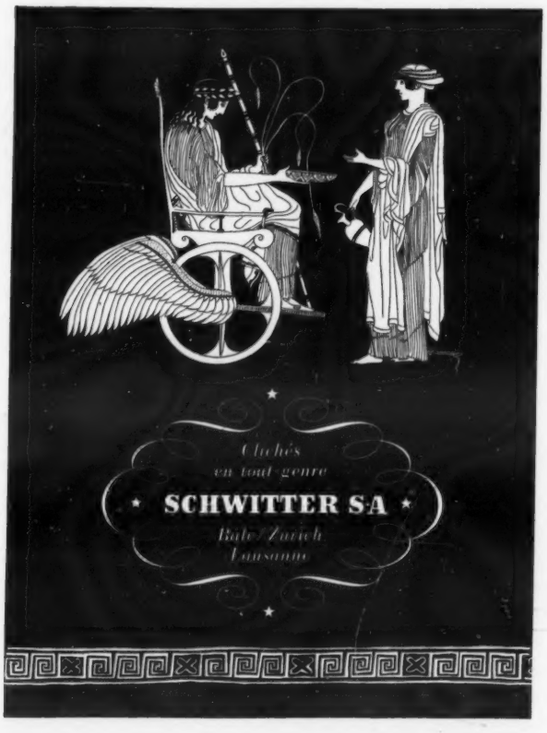
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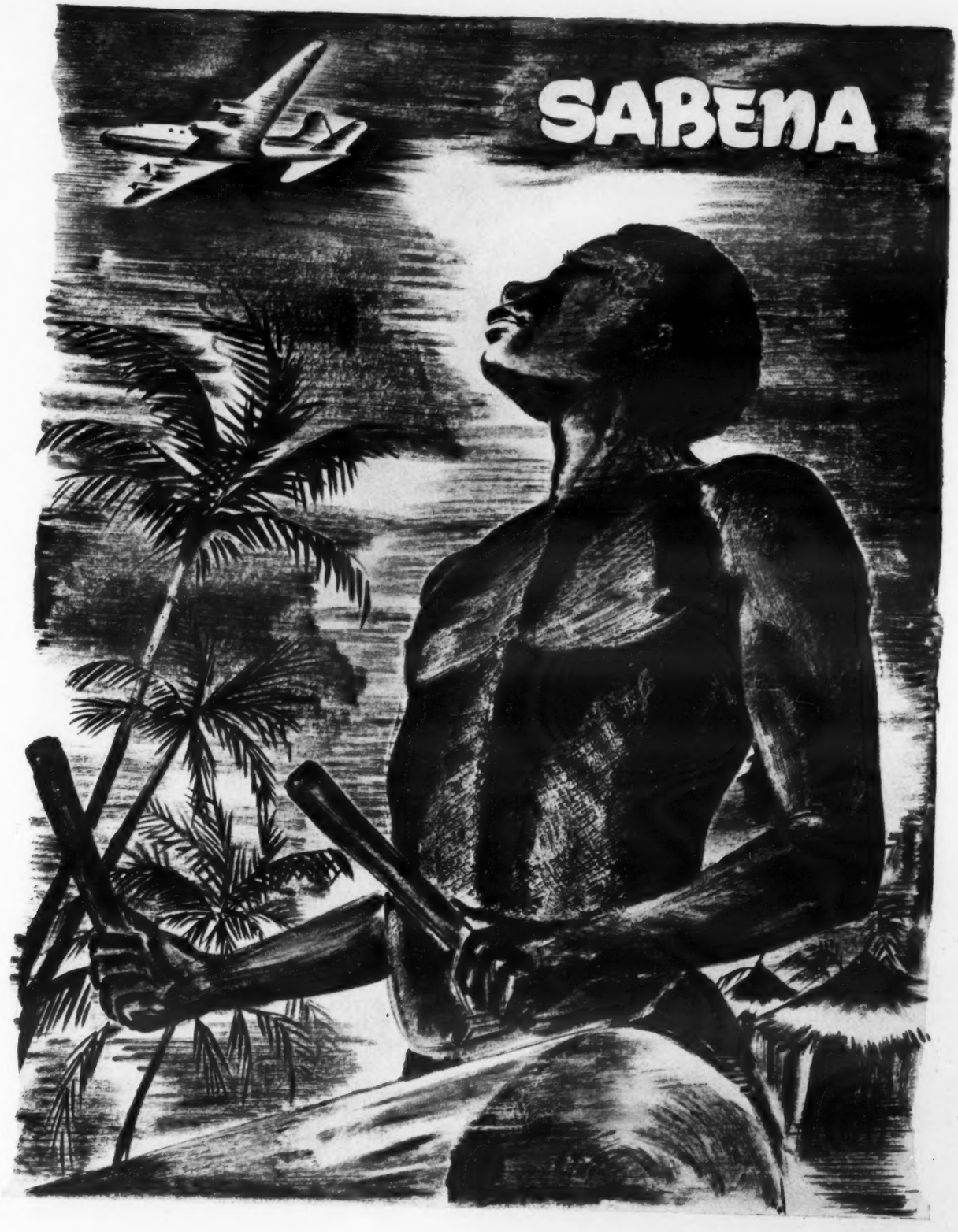

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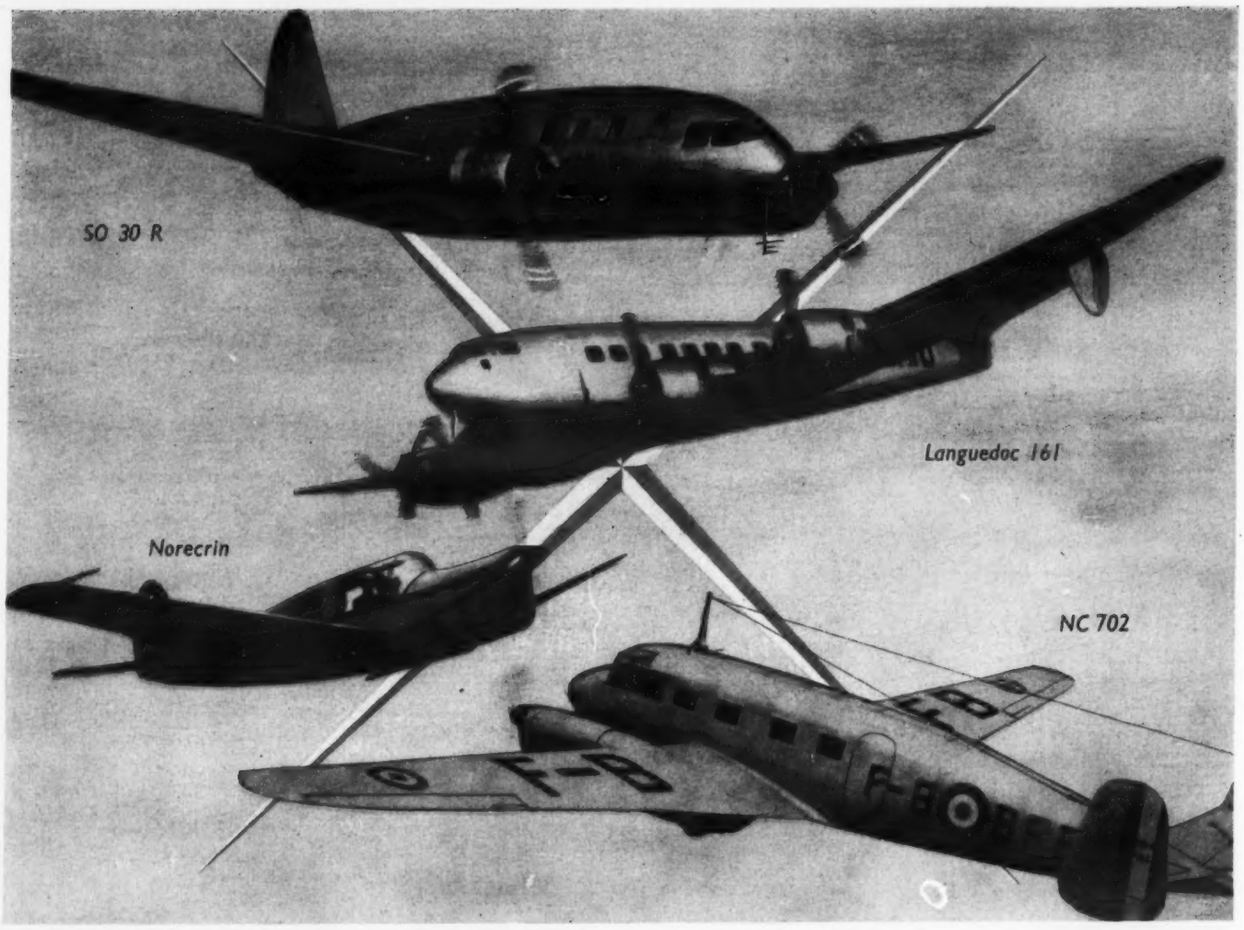

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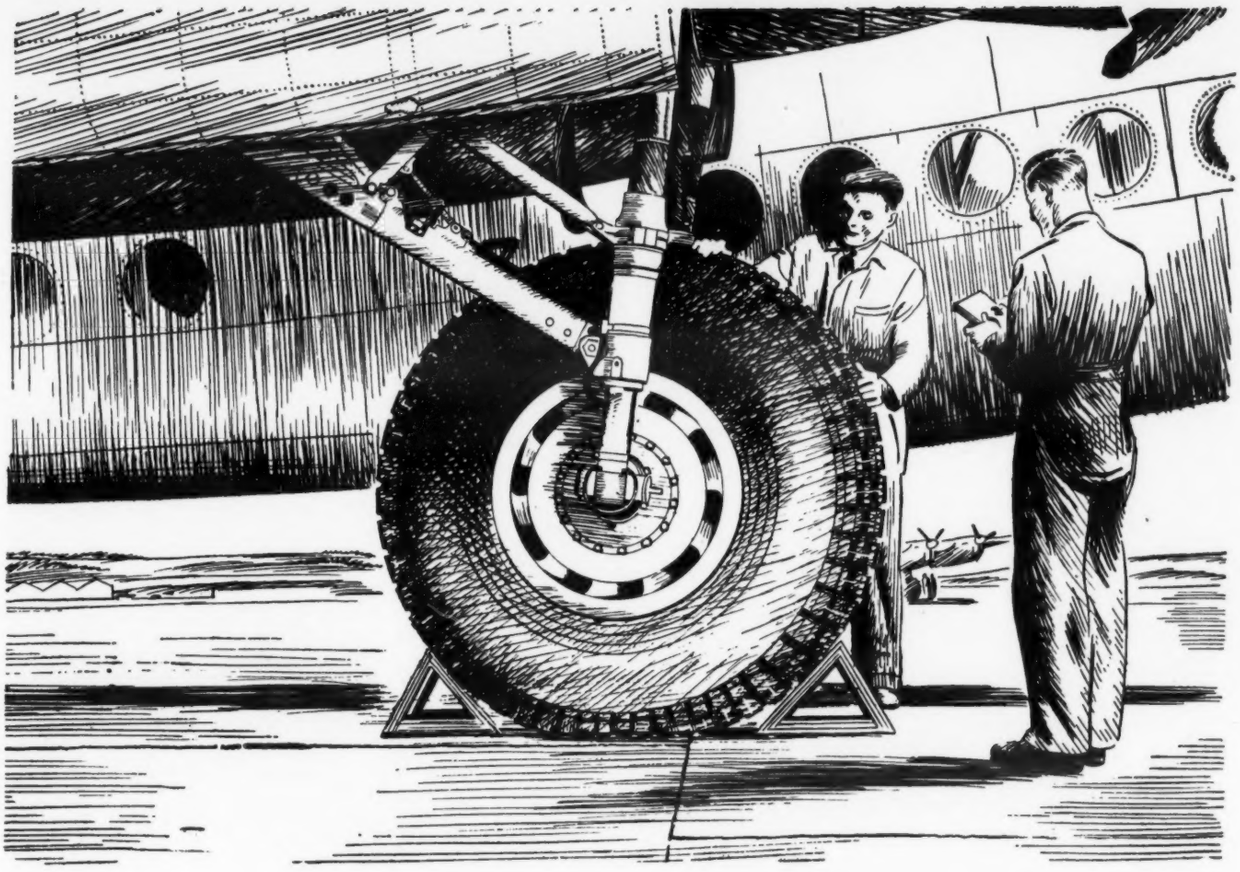

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Marginal Notes

Every cloud has a silver lining!

Discussing the *situation* with regard to the present financial plight of *Transcontinental & Western Air, Inc.*, Paul E. Richter, the airline's executive vice-president, states: "About everything that can happen to a company happened to TWA in 1946. Our situation is as critical as it was back in 1934, when airmail contracts were cancelled. We all know the record of 1946—the grounding of the 'Constellations', development expenses, costly equipment modifications, the loss of some valuable equipment and finally the strike, which came at a time when business itself was falling off. To meet this extraordinary emergency we are forced to take drastic steps. We have cut back expansion plans sharply. Orders or lease arrangements for 25 new aircraft have been cancelled. Our daily scheduled route mileage is being reduced to 113,700 miles, a cut of 22%. Many functions are being sharply curtailed and in some instances eliminated entirely. None of the programmes and hopes for the future of TWA can be realized until the security of TWA itself is assured." – *One of the Big Four in U.S. air transportation is in distress.* The concern has dismissed about 40% of 16,000 employees and urgently requires $100,000,000 to surmount its difficulties.

The TWA case does not only apply to this one company: it applies to the entirety of America's air transportation, to large parts of her industry, to a magnate of finance of international fame and—depending on the outcome—to the world's aeronautical markets. The restoration of TWA's finances is only what one sees on the surface. Behind the scenes is a tug-of-war between big firms and banks, between private enterprise and the Government.

Let us start off with Howard R. Hughes, millionaire sportsman, known almost the world over. Beginning his life with an inheritance of lucrative oil and machine concerns, young Hughes began his hectic career by achieving fame in the film industry: "Hell's Angels" caused the first sensation many years before the war; and now the world is bubbling over in controversy about the morality and immorality of "The Outlaw." In between, Hughes fell hook, line and sinker for aviation. He had Lockheed build him the L-14, with which he set up a coast-to-coast record in 1937. In 1938, he made a record round-the-world flight.

His interest was not confined to sporting flying, but embraced aircraft construction and airline operation. He formed the Hughes Aircraft Company at Culver City, California, in 1934, and has since drawn public attention with two constructions; the HK-1 "Hercules" eight-engined all-wood 700-passenger flying-boat—which has not yet taken the air—and the Hughes XF-11 twin-engined long-range reconnaissance aircraft, in which he all but lost his life when it crashed during trials last year.

As a prospective airline operator, he became friends with Jack Frye, President of TWA, a carrier which, until the war, was engaged in only Transcontinental flying. He saw wider horizons, and the appearance of Trans World Airline out of Transcontinental & Western Air, Inc., is in no small way thanks to the initiative of the airline's major shareholder, Howard Hughes. At present, he possesses 46% of TWA's 985,929 paid-up shares—quite a pile, but not worth so much today: when the share stood at $71, his holding was over $30,000,000; today, as a result of Wall Street slides and TWA's own difficulties, a share is worth only $18, which bring Hughes' stock down to about $8,000,000.

And now TWA needs money—$100,000,000. Who is going to supply it? At the beginning of 1946, when aviation was booming and everything was gay on Wall Street, the banks would gladly have granted a loan, but Howard Hughes was unwilling to accept at that time. He wanted to retain his majority and his authority. Today, the banks won't hear of it, as the client is forcedly no longer as attractive. The Reconstruction Finance Corporation can and wishes to help, but only if Hughes removes his finger from the pie. Finally, Jack Frye proposed tripling the capital to 3,000,000 shares.

This, of course, does not suit the major shareholder at all. Not only would it cause a drop in value, but a new issue of shares would above all cut down the percentage of his holding. Government intervention would mean Hughes' losing his hold on TWA and—in view of the present conditions—not only his money but probably his entire position in aviation. As for Jack Frye and the company, it entails a matter of life and death. It seems that the bond of old friendship between Frye and Hughes has deteriorated—and the Board of Directors is on the side of the President.

A stockholders' meeting was set for December 23rd, last year, in order to decide on the share increase. Hughes stayed away, with the result that, lacking a quorum, the meeting was adjourned. This performance was repeated at a second attempt on the part of Frye to call a meeting. And now, according to latest reports, TWA has accepted a convertible loan of $10,000,000 from the Hughes Tool Company. $10,000,000 may be a lot of money, but it is certainly not enough to pull TWA out of its plight.

Come what may, the airline and its major shareholder will have to take a decision before the end of January. Can TWA be reorganized on private capital, or must the Government assume the entire responsibility and thus create a situation which would be unparalleled in U.S. airline history? Can Hughes retain his major TWA holdings? At all events, TWA will not go under: it is a major national issue which, in the interest of national security, the Government cannot allow to go bankrupt. Should a man of Hughes' calibre quit the scene and disappear from aeronautical circles, it would constitute a loss to aviation.

There has always been trouble in the transport industry, and the railways were in a more serious position in 1870 than the airlines are at present. But trains are still rolling today, and aircraft will be flying again tomorrow. *Probably not before tomorrow.* – Every cloud has a silver lining!

E. E. H.

Food for thought!

In the evening of December 19th, all seats were booked up by Christmas tourists on a Douglas DC-3 belonging to Universal Airlines, Inc., a passenger charter carrier based at Newark, N. J., which was flying from New York to Puerto Rico. Whilst traversing Maryland territory, the passengers received a rude awakening and were suddenly aware that the pilot was making for an emergency landing. About 20 minutes later, a DC-4 of Eastern Airlines landed at Washington Airport, with a buckled tailplane. As it happened, Universal's DC-3 was flying Eastern's prescribed air lane, and the latter's faster DC-4 rammed the little fellow in the night. The fact that some 80 passengers emerged from this hair-raising experience without any injury to speak of, and even that everybody on board was not killed outright, can well be described as a Christmas miracle.

The Air Transport Association of America certainly had something to say about the matter. Mr John Yandel, President of Universal Airline, Inc., happened to have stated that: "Our pilots are subjected to the same rigid rules and regulations as other commercial operations, and the operations of our line are subjected to the same rules." ATAA replies: "This statement of Mr Yandel and others similar to it made recently, are misleading to the flying public. Non-scheduled pilots are required only to have a commercial pilot's licence with an instrument rating. They may pilot planes into and out of airports they have never used before, under present regulations. The scheduled airline companies' pilot requirements begin with the more rigid airline transport pilot certificate. The scheduled pilots must demonstrate complete familiarity with the routes they are to fly, and regulations require that the pilot make the run he is to fly *several* times as co-pilot before he is allowed to captain the flight. The scheduled pilots must undergo periodic instrument checks and in general are subject to constant checking of their ability by Government inspectors. These requirements are far above and beyond those for non-scheduled or charter companies. The scheduled airlines must operate into and out of airports with specific requirements as to ceiling and visibility and weight limitations, not only for each airport but for different runways on the airport in many cases... Non-scheduled operateurs, on the other hand, may land at any airport in the U.S.A. with a 500-ft. ceiling a one-mile visibility... Statements to the effect that there is similarity of safety requirements between the scheduled, certificated and charter companies, are misguiding to the passengers and shippers who use air transportation."

The point does not bear argument. But it *does* give food for thought.

THE DECISIVE YEARS

The Situation

"... it seems as though the hub is over on the other side of the Herring-Pond to stay..."

This phrase, contained in a New Year letter from a European colleague, refers, of course, to the hub of the aircraft industry.

In order to appreciate the full import of this hub, let us begin 1947 by recapitulating.

At the outbreak of war, in 1939, the American aircraft industry, with an annual production worth $250,000,000, ranked 41st among the different branches of American industry. At that time, the annual production of the American automobile industry stood at $4,000,000,000, thus sixteen times as big. Five years later, at the peak of the national war effort, the production potential of the American aircraft industry had been raised to $16,000,000,000—sixty-four times the pre-war figure—and found itself at the head of all branches of American economy. Never before in history has there been such an expansion in a single industrial group. In five years the number of employees rose from 50,000 to approximately 2,000,000, and about 6,000,000 Americans were connected with either the civil or the military side of the aircraft industry.

The expression "American Century" was coined and, henceforward, "Air Age" was the correct term. However, many people failed to realize that this era had started rather suddenly, and that the aviation industry—like all war babies—had grown under stormy conditions and in a manner which was not absolutely healthy.

In 1939 the American aircraft industry was able to turn out 5,855 units, representing a total constructional weight of about, 8,000,000 lbs. In 1940, President Roosevelt announced his programme, which many people declared was impossible, for an annual production of 50,000 aircraft. And, in 1944, this industry delivered—believe it or not—96,359 aircraft, totalling 965,000,000 lbs.

This was how the case presented itself practically, this was the situation.—By drawing on parts of the automobile industry and its ancillary branches, the U.S. aircraft industry grew to be the most important manufacturing activity in the world, and the deciding factor in the last world war.

1946, the first post-war year, is behind us. An industry inflated to gigantic proportions in order to meet war requirements has to revert to its normal size and adapt itself to peace-time conditions. This process of re-adaptation is full of dangers, despite the fact that it is facilitated by the Government. A turnover of $16,000,000,000 has to be dragged down to $1,000,000,000, and an annual production of 96,000 aircraft, mostly heavy types, must be reduced to 30,000 units —to state the most optimistic figure—which will, for the greater part, be light aircraft. Of 2,000,000 employees, 1,850,000 have to be discharged and a nucleus of only 150,000 retained. From its position at the top of the ladder, the aviation industry has to climb down to a much lower rung. In doing so, it has to avoid economic dangers which, given the chance, could deal the whole industry a death blow.

We have before us an economic paper dealing with the process of reconversion, started in 1946, which asks the following question:

From which sources will the American aircraft industry draw its principal orders in the immediate future and what, exactly, is the importance of these sources?

The hub is over on the other side of the Herring-Pond... The reply to the above question has not merely to decide on the ups and downs of the industry, but most of all on aeronautical activity of the years immediately ahead, according to whether—as the world hopes and desires—these remain peaceful.

* * *

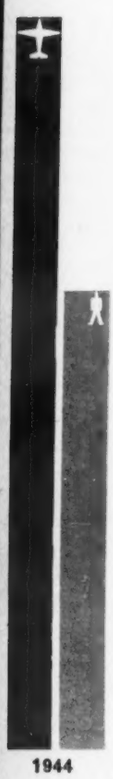
In this era of hustle and bustle, some have forgotten the origin of the American aircraft industry. Others, especially the latest generation of fliers, have perhaps never known it.

The aviation industry in America differs in many respects from parallel activities in Europe. While the latter rely heavily on military orders and carry these out to Government specifications, the American industry turned—at least up to the war—to its own resources and collaborated closely with the airline companies. It was above all a peace-time undertaking which sought foreign markets, and military contracts were but a small item on the ledger.

Forced to stand on its own feet, it had to fight for its existence. It managed to invade foreign markets all right, and every time thanks to the personal ability of the firms concerned. And small as it was, it left its mark in prominence. Already then, it invented equipment which is still produced under licence in foreign countries and is still today regarded as modern.

It was the American industry which produced the first high-speed aircraft, the first twin-engined models, retractable undercarriages, variable-pitch airscrews, landing-flaps, automatic pilots and numerous other commodities which, today, are taken for granted. No other aircraft industry in the world has known more progressive constructors and more adroit salesmen. But from the point of view of quantity, the industry stayed relatively modest until 1939, at which moment the final occupant of the Reichskanzlei unwittingly threw open the doors of the world to it.

War threatened and America received her first big contracts from France and Great Britain. France collapsed and Roosevelt launched his programme for 50,000 aircrafts. Then came the American Lease-Lend legislation which gave the United Nations possibility of obtaining large quantitites of American flying equipment without having to pay cash down for it. A peace industry had become a war industry.



Reconversion of the American aircraft industry to peace-time production.

1944 turnover: $16 billion — Payroll: 2 million.
1946 turnover: $ 1 billion — Payroll: 150,000.

"No other aircraft industry has known more progressive constructors:" California High School students with model jet developed at "School of Engineering for Speeds."

In five years, from July of 1940 to July, 1945, it produced 296,601 aircraft, of which 3,454 were very heavy four-engined bombers, 30,982 heavy four-engined bombers, 62,420 twin-engined military aircraft, 98,703 fighters, 23,664 twin and four-engined transports, etc. To see Herr Göring read these figures! In any case it was more than all the other aircraft industries of the world put together could produce.

Fourteen firms were the major participants in this production. Their working capital in 1939 was estimated at about $64,000,000, which increased during the war to approximately $585,000,000. By contrast, their nominal shareholding capital remained more or less unchanged, which shows that they did not want to plunge into any financial escapades. Here lies one of the assets of the industry, which should serve to facilitate its process of reconversion.

Other assets include: modern factory equipment which has all been written off to the last cent. Exceptional experience in developmental work and mass production. Liberation by the Government of all committments regarding shadow factories and auxiliary plants of which the construction was necessitated by the war. An accommodating attitude on the part of the Government as regards cancell-

"... and more adroit salesmen:" Glenn L. Martin, president of Baltimore aircraft firm bearing his name, receives French Air Force delegation...

and demonstrates model of Martin 2-0-2 twin-engined transport to C. Bedell Monroe, president of Pennsylvania-Central Airlines.

ation of war contracts, whether only placed or in the course of being executed. The right to reclaim part of their war profits taxes should reconversion to peace-time activities make this a necessity. And, finally, the policy of the War and Navy Departments, for easily understandable reasons of national defence, not to knock the bottom out of the aircraft industry from one day to another, but, on the contrary, to keep it alive by placing limited production contracts and financing expensive developmental and research projects.

And one asset which has not yet been made available: for the moment Washington has no policy of protectionism, and is leaving the U.S. aircraft industry to fight for itself in the battle of international competition. The fact that during the first year of peace British exporters were able to set foot in South America, a dollar area, speaks for itself.

The prospects

Earlier on it was asked from which sources will the American aircraft industry draw its principal orders in the immediate future and what, exactly, is the importance of these sources.

Let us take *one source* to start with, which was one of the most plentiful and now runs more feebly: *aero engine construction.*—The two major producers of big aero engines were, and still are, Curtiss-Wright Corporation, through its Wright Aeronautical Corp. division, and United Aircraft Corporation through its Pratt & Whitney Aircraft Division, In 1944, the first concern delivered $1,700,000,000 worth of material and the second, around $750,000,000.—What about today? In 1946, Curtiss-Wright deliveries amounted to only $45,000,000, that is to say, only 2·6% of the 1944 figure, and United Aircraft only $95,000,000, which all the same denotes 12·8%. What are the causes of this astonishing retrogression? Reduction in activity and general reconversion are not the only reasons. Towards the end of the war a new type of engine appeared, the jet-propulsion engine, and these two firms have so far nothing to offer in this field. Competition is looming up from powerful industrial groups such as General Electric, General Motors, Westinghouse, Allis-Chalmers and also, perhaps, Packard. The first impression one gains is that the two, hitherto leading American aero engine manufacturers have missed the boat, for the time being at least.

Another source, about which more noise was made than was warranted: *sporting and touring aircraft construction.* It may still be recalled that, immediately before the cessation of hostilities, the U.S. Civil Aeronautics Administration made a "conservative" estimate that, in 1955, more than 400,000 civil aircraft would be in service in the U.S.A. A market was foreseen for 280,000 sporting and touring aircraft, 40,000 executive transports for big firms and 80,000 aircraft for commercial aviation or for use in flying schools. What is the result so far? If 25,000 sporting and touring aircraft were constructed and sold during 1946, it is a lot. Though it must be conceded that in reply to a questionnaire, 85,000 Americans declared that they would "just love to buy an airplane", closer scrutiny revealed the larger part of them to belong to the inquisitive rather than the buying public. And even if 25,000 light aircraft actually did find buyers, this represents, at an average price of $3,000 a unit, a total value of $75,000,000 —hence, a mere drop in the ocean. The world's largest aircraft industry will certainly not grow fat on that amount.

All the same, the signs are that a certain interest in touring aircraft will be manifested during the next few years, and large firms such as North American Aviation Corp. with its "Navion", Republic Aviation Corp. with its "Seabee" amphibian, Cessna Aircraft Co. with its Cessna 120 and 140, Stinson Aircraft Division (Consolidated-Vultee) with its Voyager and Beech Aircraft Corp. with its "Bonanza" seem to be taking note of it. These models, however, ranging in price between $5,000 and $10,000, do not belong in the really cheap aircraft category.

A newly-sprung source seems to be *helicopter construction*, in which 16 American firms are at present engaged. Outstanding among these

J. H. Kindelberger, president of North American Aviation, Inc., paints "NC", sign of official acceptance as commercial aircraft, on wing of "Navion" in presence of two Civil Aeronautics Administration officials.

are: Sikorsky, Bell, Bendix and Kellett. Right now, rotary wing aircraft is no longer a stunt, but a reality, for the industry is being materially encouraged by the U.S. Army, Navy and Post Office Department.

The *surest source* of all is still the Government, through the medium of the War and Navy Departments. Even if the *U.S. Army Air Forces* do not contemplate building up huge stocks of new aircraft—which, besides, could only be transitional machines—it is not leaving its old suppliers entirely in the lurch. The latter may not be receiving production contracts for hundreds or thousands of any specific type, but orders for from fifty to a hundred aircraft at a time—either jet fighters, very heavy bombers or long-range transports—all the same represent yearly contributions of about $7,000,000,000. Incidentally, opinions are at variance as to whether the Army and Navy have to order two or three thousand aircraft annually in order to replace obsolete equipment, acquire new types for training purposes, and to keep the embryon of a war industry alive. To all this must be added orders, concerning the composition and volume of which one hears very little or nothing, which doubtlessly embrace remote-controlled aircraft, long-range and anti-aircraft missiles, flying-wing aircraft, new radio equipment, etc.

Times have changed: the experiences of the last war have made it clear that a peace industry is obliged to remain, to a certain degree, a war industry. And herein lies an asset towards the process of reconversion. To this asset must be added another, which, despite its apparent veneer of peace, remains, as events have taught us, indispensable in modern warfare: the *construction of commercial transport aircraft.* Herein once lay the strength of the American aircraft industry, and herein, unless the stars tell lies, will be its *future* again.

Works of Consolidated Vultee Aircraft Corp. at San Diego, Calif. At top edge of photo, three shops of shadow factory operated during the war by Convair under Government contract.

Aviation Industry and Commercial Aviation

When war broke out, trans-ocean air traffic of a sort already existed. The French were the first to start it, whereby they first of all organized a South Atlantic service with fast packet boats and confined their aircraft operations to flying down the coasts. The Germans carried this a step further and catapulted multi-engined seaplanes from floating bases anchored off the coasts. Then Pan American Airways proved that, under more or less favourable weather conditions, four-engined flying-boats could conquer the seas. In all these efforts, however, it occurred to nobody to use anything other than flying-boats.

War came and American-produced aircraft had to be delivered to the front line ready for service as quickly as possible. To dismantle them, load and unload them, and re-assemble them ready for further test flights would have been vastly complicated and in fact altogether impossible. Apart from the loss of time and money, the lack of shipping space already precluded such a procedure. Therefore, the most appropriate and most simple method was selected, and a risk was run, of which the significance was obscured by the urgency of victory. Landplanes began to fly the North Atlantic, South Atlantic and Pacific at intervals of a few minutes, and in this way fed the fronts in Europe, Africa and the Far East. *Thus, the war provided the foundation for trans-ocean air traffic, which today, as it will tomorrow, relies on landplanes.*

It is hard to find words to praise the airlines for the supreme mental effort they made to re-establish their overseas routes. As during the war, they are using former military air bases—though they be called Iceland, Newfoundland or Ireland—as staging posts. From the climatic point of view the Azores represent a commendable exception. The same routes are flown as were by transport command units of the air forces and, for the moment, even the same types of aircraft are used: Douglas DC-4's and, if the company is very progressive, Lockheed L-649 "Constellations".

Plans are drawn up and flights are made. In March, 1946, PICAO held its first North Atlantic Air Route Service Conference in Dublin, at which it was agreed that airlines of eight nations could, or had to, provide 63 North Atlantic return flights each week: the Americans 22, the British 14, the French 14 and the Dutch, Belgians, Swedes, Danes and Norwegians, the 23 remaining. The situation seemed to have become precarious for the North Atlantic shipping companies, but the weather gods and the shortcomings in airline ground organization came to their aid. Just as years are required to construct a seaport, intercontinental airports cannot be built in a day.

1946 was a good year for trans-ocean air traffic. It was possible to keep to schedules to a certain extent, the crews had learned to know the routes during the war, flights were carried out with care and judgement, at the start, there were no accidents to record. On a statistical basis, aviation insurance companies could consider the risk bearable—only one fatal accident to a passenger for 46,000,000 passenger-miles—and they raised their premiums only very slightly.

The shipping companies had not yet recovered from the war, people were fighting to get seats on aircraft.

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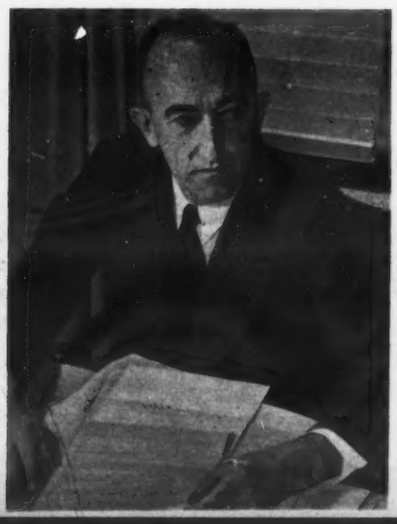
Such were the conditions that the American aircraft industry found and needed. Specialized already before the war in the construction of commercial aircraft, it had pursued its development in the creation of long-range military transports. It should be added here that, before the war, American airline companies more or less co-incided in their choice of certain types of aircraft: of 345 American commercial aircraft in service during 1940, 283 were Douglas DC-2's or DC-3's, 33 were Boeing 307's or obsolete Boeing 247's, and 29 were twin-engined Lockheed 14's or 18's. Douglas, followed by Lockheed, set the pattern of the aircraft procurement policy of pre-war civil aviation in the New World.

One of Boeing Aircraft Company's two factories. Workshops concealed by war camouflage, representing an unimportant country settlement.

To crank this business up again, giving it life and expanding it, thus considerably fostering its reconversion to peace conditions, was and still is the obvious task of the American aircraft industry.

In the meantime, *Douglas Aircraft Co.* built 10,123 C-47 (DC-3) twin-engined and 1,162 C-54 (DC-4) four-engined transports during the war, in all 11,285 transport aircraft out of a total of 29,385 units produced by this firm during the course of hostilities. Second on the list of producers of transport aircraft is *Consolidated-Vultee Aircraft Corp.* which, however, produced only a few transports, but several thousand heavy bombers: B-24 "Liberators" of their own development and Boeing B-17 "Flying Fortresses" built under licence, rolled off their assembly lines. With the financial aid of the Army Air Forces, this firm had also developed a six-engined long-range aircraft, the C-99, from which was to be derived the Consolidated-Vultee CV-37, ordered by Pan American Airways.



William M. Allen, President of Boeing Aircraft. Co.

The third place went to *Lockheed Aircraft Corp.*, a fairly small firm before the war and whose first big clients were the British, who ordered some 2,900 Lockheed L-14's ("Hudson"). It is a Lockheed distinction that it was able to exist before the war, not altogether brilliantly, but without too many worries, on the business that it carried on with airline companies. The company kept this in mind during the war when it developed a four-engined, long-range transport for the Army, under the designation of C-69, from which the present "Constellation" was developed, the successor of which, the "Constitution", already shines in the Lockheed firmament.

Let us take the fourth firm, *Boeing Aircraft Co.*, which did not exactly strike a gold mine with its few deliveries to Pan American Airways before the war, but which, during the war, was to learn how to produce four-engined heavy bombers in series: with 6,981 four-engined B-17 bombers and 2,704 four-engined B-29 very heavy bom-

bers, Boeing at present holds the record for the greatest number of heavy aircraft to be produced by a single concern. With its C-97 military transport, developed from the B-29, and the logical successor, the B-377 "Stratocruiser", Boeing has been able to compete with success and has already obtained orders in America and Sweden for some 50 aircraft of this type.

The picture may be rounded off with mention of Republic Aviation Corp. and The Glenn L. Martin, Co., on whose ledgers commercial aviation orders are entered alongside considerable sums.

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To call it a source now is to under-rate it—*a little brook already flows*. During the course of the summer of 1946 the American aircraft industry had already received *orders from airlines for about $350,000,000*. By adding on the $700,000,000 represented by Army contracts, one has the vital minimum for the "peace-time industry."

But let us stick to commercial aircraft production, the prospects for which look to be fairly promising. As on earth there is room for everyone, one might be led to think that the same applies for the sky! But one would be misled, in this case; and it is only necessary to look at the competition going on to see why.

For the moment the British, French, Dutch, Belgians, Swedes, Norwegians, Danes, Swiss, Spaniards and South Americans are buying American transport aircraft, whether they want to or not. There is no other sort of flying material available in this category. The fact that the British are developing their own four-engined aircraft and that the Russians are, for the moment, reticent in this connection, does not make the slightest difference.

Just how lively is the *struggle for the markets of today and tomorrow* is shown by the case of two American firms which are both powerful, produce similar equipment and each has a global organization at its disposal. We refer to *Douglas and Lockheed*. A brief comparison of the development, organization and most recent aircraft of these two concerns will certainly be useful.

In this way one will learn, to a certain degree, what the American aircraft industry has to offer in the way of long-range airliners. We shall intentionally pass over the Consolidated CV-37, the Boeing B-377 and the Republic "Rainbow", as no actual production programme has yet been formally announced for these types. Within the frame-work of the reconversion of American aircraft industry, the question will crop up as to whether one can still speak of, or count on, serial production at all, as regards heavy transports. Will aircraft actually be mass-produced at a unit price between $1,000,000 and $2,000,000? Or will technical and financial set-backs in the near future compel the U.S. aircraft industry to resort to unit manufacture, like the shipbuilders, and to seek out individual customers? Those times when one could expect the State to brave the risks entailed in the development and prototype construction of such expensive aircraft are now over.

Donald W. Douglas, Founder and President of Douglas Aircraft Co., Inc., Santa Monica, Calif.

Tool shop at Douglas Aircraft Company's at Santa Monica.

Douglas and Lockheed

The *Douglas Aircraft Co., Inc.*, was founded in 1920 by Donald W. Douglas; it was re-organized in 1928 and provided with the necessary financial means. From the financial point of view this concern is one of the most conservative and sound in the American aircraft industry. Since 1936, despite gigantic factory expansion, its shareholding capital has remained the same, or almost so, in the sense that it underwent a slight increase in 1939: the number of $10 common shares was raised from 560,800 to 600,000. The 1936 annual turnover reached the still relatively modest sum of $7,900,000; in 1939 it was almost four times as great—$28,000,000, and in 1944 the peak total of $1,061,000,000 was realized. Out of 150,000 employed in 1944, only 30,000 figured on the 1946 pay-roll; and reconversion will require still further retrenchement. Quoted at $109 during the boom period at the beginning of 1946, the Douglas common share is at present worth about $75.

The concern possesses a working capital of about $66,000,000 and various reserves amounting to approximately the same sum. Whether General Motors have a share in the firm and, if so, to what extent, is not easy to ascertain. In any case, Douglas shares are in a great many hands. A prudent financial policy is discernible behind a recent declaration by the concern's president and founder, who prophesies no substantial profits for the immediate future. It is highly improbable that Douglas' gross revenues for 1946 will have exceeded $150,000,000, and the greater part of this would be entered alongside Army contracts.

The range of aircraft developed by Douglas again testifies to the firm's conservative policy: twin-engined and four-engined transports are always in the foreground. In addition, the company produced single and twin-engined bombers and attack bombers already before the war. From the DC-1 transport of 1933, the DC-2 and ultimately the DC-3 were developed. Then the DC-4 served as basis for the latest

Robert E. Gross, Reorganizer and President of Lockheed Aircraft Corporation, Burbank, (Calif.).

Lockheed Aircraft Corporation's plant at Burbank.

Douglas airliner, the DC-6, which originally answered the requirements of United Air Lines for trans-Continental operations. Originally scheduled for delivery at the end of last year, various delays have hampered production, so that major deliveries are not to be expected before the middle of 1947. In addition, the Army Air Forces ordered 14 large C-74 (DC-4) four-engined transports, but it remains to be seen whether development of this model will be continued. In the meantime, construction of a new type of twin-engined commercial transport with co-axial pushers mounted at the rear, the Douglas DC-8 (developed from the XB-42 "Mixmaster" bomber), was abandoned.

Since the achievement of large-scale production of the Douglas DC-4, *the four-engined DC-6 is now at the forefront of the concern's interest.* Fixed contracts for seventy of these aircraft have been obtained from American, Dutch, Swedish and French airline companies.

And now let us pass to the competing firm, *Lockheed Aircraft Corp.* The story of this concern, or more exactly that of its president, Robert E. Gross, was already related in No. 1 of this magazine (April, 1946). It was with the most scant resources that Robert Gross took over in 1932 a firm which found itself at that time in a precarious situation. Its capital in 1936 consisted of 657,546 common shares of a nominal value of $1 each, which has since been increased to 1,075,960 shares. The 1936 turnover of about $2,000,000 was to reach $35,000,000 in 1939, thus surpassing that of the Douglas concern. The peak year was 1944, when gross revenues totalled $612,000,000. The 1944 pay-roll of approximately 100,000 shrunk to 17,000 in 1946, and a further reduction to about 7,000 is envisaged for 1947. At the time of the 1946 boom, the Lockheed share, of $1 nominal value, was worth $45; today it is quoted at about $20.

Neither is the record sheet of Lockheed projects soiled by any risky undertakings. The Lockheed 10 light transport gave birth to the two pre-war Lockheed 14 and 18 twin-engined transports, which later found military application under the names "Hudson" and "Ventura" and were produced in large numbers for the British and the Americans. During the war Lockheed turned out a total of 19,200 aircraft, a certain number of which were Boeing B-17's built under license, but which also included a twin-engined single-seater fighter of their own design, the Lockheed P-38 "Lightning". Shortly before the end of the war, development began of the so far best known American jet fighter, the Lockheed P-80 "Shooting Star", which, from the financial viewpoint, facilitated the firm's reconversion programme. Finally, with the financial aid of the Army, Lockheed developed the four-engined C-69 transport, which was followed by a civil counterpart, the *Lockheed "Constellation"* four-engined airliner. It is this type, which belongs in the same class as the Douglas DC-6, that constitutes the firm's *best seller* for the present. Plans established for the still larger four-engined "Constitution" airliner, at present undergoing test flights, have for the present to leave the way clear for the "Constellation". Projected production of a smaller twin-engined transport, the Lockheed L-75 "Saturn", were abandoned last fall. As for the Lockheed "Constellation", probably about 70 units have already found places on the world market.

The stake of the struggle between Douglas and Lockheed is at present the clientele for the only two available four-engined transports in the 50-passenger bracket, the Douglas DC-6 and the Lockheed "Constellation". From the point of view of size, pay-load and performance, there is not much difference between these two aircraft; preference for one or the other could only be in relation to its operation on one particular route, while the respective advantages and disadvantages balance evenly when different routes are flown over longer periods.

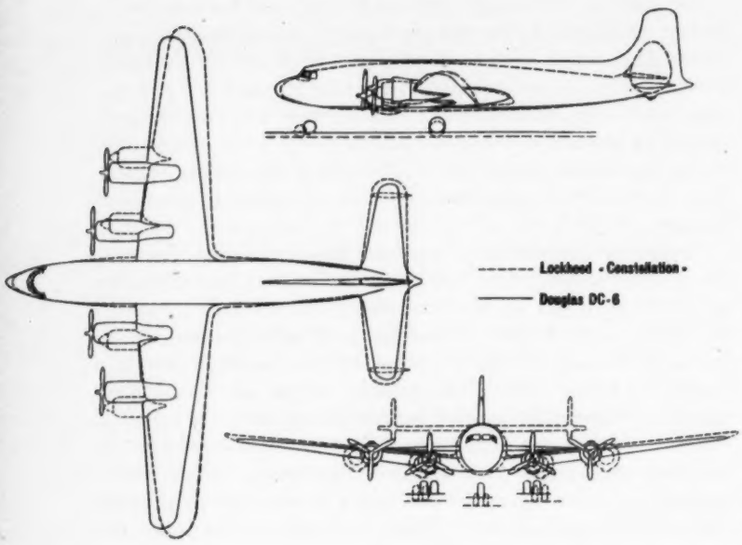
Though the *"Constellation"* embodies data gained from the operation of the earlier Lockheed twin-engined machines, its construction and external aspect all the same incorporate the new theoretical knowledge acquired during the last few years before the war. Thanks to early planning for peace-time production, Lockheed was in a position to offer a modern trans-Atlantic transport at the end of the hostilities. Consequent upon a number of accidents, the causes of which could only in a small proportion of the cases—and then only to a very slight degree—be attributed to mechanical defects, general enthusiasm for the "Constellation" began to wane during the second half of 1946; again, adroit advertising by Lockheed's competitor was well-timed to influence the public in this respect. The more progressive the conception of a new aircraft, the greater also is the risk of difficulties being encountered at the start of its service. Lockheed confirmed this rule at its own expense.

The *DC-6* design is based on a different conception. At the start of the war Douglas Aircraft Co. had completed the DC-4 which the U.S. Army Air Forces used in large numbers under the designation of C-54 "Skymaster", and which has since proved its ability to meet every operational requirement. It would be natural to ask whether the number of accidents due to technical defects entailing DC-4's during the war were not as numerous, in proportion, as those recently suffered by the "Constellation". Unfortunately, the answer remains bound up in military secrecy, so that a comparison in this respect is scarcely possible. In the design and development of the DC-6, Douglas engineers set themselves to create, with the minimum loss of time, a modern four-engined long-range airliner, in size similar to the 'Constellation," which would resemble the DC-4 to as great a degree as possible and would even allow for an extensive taking-over of certain parts without substantial modification. As a result of this principle, the DC-6 is fitted with a wing which, apart from a few minor changes, is that of the DC-4, whereas the fuselage is also the same, at least externally, as that of the DC-4. The table below of dimensions, weights and performance brings out the analogy between the two aircraft. Of the various existent versions of the two types, we have chosen, as examples, the two respective models which the constructors themselves call their "latest" types: the *Douglas DC-6 MC-2* and the *Lockheed "Constellation" 749/79.*

In the table below performance data are calculated without exception for the maximum permissible weights. Since the inception of the two prototypes, the maximum take-off weight of each has been stepped up several times, and it is not regarded as unlikely that the U.S. Civil Aeronautics Administration may permit still further load

DIMENSIONS	DC—6 MC—2	Constellation 749/79
Span	117 ft. 5½ in.	123 ft. 0 in.
Length	100 ft. 4¾ in.	95 ft. 1 in.
Height	28 ft. 6 in.	23 ft. 0 in.
Wing area	1,460 sq. ft	1,650 sq. ft.
POWER PLANT	4×P&W CA75	4×Wright Cyclone C18BD1
Rated power	1,800 H. P.	2,100 H. P.
Take-off power	2,100 H. P.	2,500 H. P.
Max. continous power	1,600 H. P.	1,800 H. P.

WEIGHTS		
Max. take-off weight	91,290 lbs.	100,100 lbs.
Max. landing weight	73,070 lbs.	82,500 lbs.
Empty weight	50,100 lbs.	59,042 lbs.
Tare weight	51,330 lbs.	60,350 lbs.
Operational tare weight	53,480 lbs.	63,475 lbs.
Disposable load	37,810 lbs.	36,635 lbs.
Payload (average density):		
Passengers (160 lbs. each)	(52) 8,600 lbs.	(50) 8,270 lbs.
Cargo (10 lbs. each cu. ft.)	5,190 lbs.	4,420 lbs.
Cargo capacity	517.7 cu.ft.	440.0 cu.ft.



Fuel capacity (normal)	2,577 U. S. gals.	4,600 U. S. gals.
Fuel capacity (additional).	1,623 U. S. gals.	1,100 U. S. gals.
Fual capacity (total)	4,200 U. S. gals.	5,700 U. S. gals.
Max. weight of fuel	25,578 lbs.	34,730 lbs.
Oil supply	959 lbs.	1,654 lbs.

PERFORMANCE

Cruising speed at 4,900 ft.		
at 50% rated power.	222 m. p. h.	240 m. p. h.
at 60% rated power.	249 m. p. h.	257 m. p. h.
at 70% rated power.	270 m. p. h.	275 m. p. h.
Cruising speed at 9,850 ft.		
at 50% rated power.	227 m. p. h.	239 m. p. h.
at 60% rated power.	257 m. p. h.	268 m. p. h.
at 70% rated power.	281 m. p. h.	291 m. p. h.
Cruising speed at 19,700 ft.		
at 50% rated power.	230 m. p. h.	250 m. p. h.
at 60% rated power.	268 m. p. h.	290 m. p. h.
Rate of climb at sea level and max. continuous power	1,150 ft. min.	1,330 ft. min.
Rate of climb (three engines) . . .	623 ft. min.	738 ft. min.
Service ceiling (four engines) . . .	24,930 ft.	24,610 ft.
Service ceiling (three engines). . .	19,030 ft.	18,860 ft.
C.A.R. runway requirements . .		
Take-off at sea level	6,430 ft.	4,860 ft.
Take-off at 1,480 ft.	6,960 ft.	5,320 ft.
C.A.R. landing run	4,860 ft.	4,230 ft.
Landing at max. landing weight over 50-ft. screen	2,920 ft.	2,540 ft.
Wing loading at max. take-off weight	62.4 lb./sq.ft.	60.6 lb./sq.ft.
Wing loading at max. landing weight	50.0 lb./sq.ft.	50.0 lb./sq.ft.
Power loading at max. take-off weight	10.8 lb./H.P.	9.9 lb./H.P.

increases. In this way, there is already question of raising the take-off weight of the Douglas DC-6 MC-2 from 91,200 lbs. to 93,000 lbs.

A comparison of the two airliners, whereby the Lockheed "Constellation" 749/79 seems to be more advantageous for short routes as it is equipped with an additional freight container, shows the latter type to be superior as regards cruising speed as well as take-off and landing performance, whereas the DC-6, which features a somewhat higher payload, appears to be more suitable for long-range operations. Meanwhile, however, unfavourable weather factors such as strong headwinds could bring about long-range conditions which the DC-6 would have difficulty in contending with owing to its lower fuel supply.

At the beginning of this year the first DC-6's were delivered to two U. S. airline companies. Serial production has been stepped up to the point where delivery of aircraft so far ordered—the manufacturers have already received contracts for over 100 units—will be able to follow on without interruption. Next year, therefore, the airlines interested will have the opportunity of comparing the operation of the DC-6 with that of the "Constellation". Meanwhile, this will not be limited solely to a comparison of actual results obtained in flight but will also give carriers an opportunity to compare the service the two companies render or endeavour to render to clients as regards giving advice and supplying spare parts.

* * *

It would appear that we are not the only ones interested in these considerations. No sooner have we our article down on paper than we find that the well-known American weekly newsmagazine, "Time", has summarized the same subject in its issue of January 6th, 1947.

Briefly outlined is that Douglas Co. has a backlog of orders for about $200,000,000 worth of DC-6's and military aircraft. Moreover, they have a promising twin-engined five-seater executive tourer in preparation. And Donald Douglas, who has managed to earn his company $3,000,000 for the first nine months of 1946, is sceptical for the immediate future but optimistic as regards long-range prospects.—His opinion is shared by Glenn L. Martin, who has orders on hand for 350 Martin 202 and 303 twin-engined commercial transports, amounting likewise to about $200,000,000.—By contrast, Robert E. Gross, president of Lockheed Aircraft Corp., announces an operating loss for 1947, as "Constellation" production is giving trouble and a twin-engined feeder project ("Saturn") has been abandoned. However, Lockheed's backlog all the same aggregates some $156,000,000.—Boeing Aircraft Co. is also able to show a $200,000,000 backlog sheet; the first Boeing "Stratofreighter" four-engined cargo transport of a series of ten units ordered by the Army Air Forces has already been delivered. Forced, however, to abandon plans for a twin-engined transport, the firm lost over $1,000,000 during the first six months of 1946.—Similar news comes from Consolidated-Vultee Aircraft Corp., who report an operating loss of $1,000,000 for the first three quarters of 1946; and this despite orders received for $348,000,000 worth of aeroplanes, prominent among which is the Convair 240 twin-engined commercial transport.—Republic Aviation Corp. does not constitute an exception; losses were incurred despite fixed orders for 26 "Rainbow" high-speed four-engined airliners. First deliveries of this aircraft were repeatedly delayed and are now announced for the end of 1947.

What is to be concluded from all this? Nothing other than what was stated at the beginning and is now confirmed by "Time": the airline and aircraft industries are both full of promising prospects and possibilities. But Army and Navy contracts for the development of military equipment for the present still form the foundation of industrial production.

What, then, are the prospects of the American aircraft industry for these decisive years? The picture, as represented, is not entirely uniform: Douglas can count on profits for the moment; Lockheed has to contend with losses. One discouraged U. S. airman is quoted as having said: "When Don Douglas starts saying things are going to be rosy, you can bet there's going to be trouble."

The decisive years commence on a note of uncertainty. But trouble at the beginning is of no importance, if the air world can look forward to a "happy ending."

TRANS-ATLANTIC FLIGHT

May 21st, 1947, will mark the twentieth anniversary of the first non-stop aeroplane flight across the North Atlantic in an easterly direction.

An American test pilot had been watching weather reports from the Old and New Worlds for months. One morning he took the fateful decision, climbed aboard his aircraft, loaded up with fuel to its maximum capacity, and set course, pinning his faith on his lucky star. And after a flight of 33½ hours, Charles Lindbergh was hailed by the masses as he landed at Paris Airport.

Judged by standards of those days, Lindbergh's flight was by no means undertaken in a wanton manner. But his planning bears no resemblance to present-day flight preparations, which are not only possible but a matter of course, and which regulate every part of trans-Atlantic flights down to the last detail. Nevertheless, even in this era of regular trans-Atlantic passenger flying, the difficulties, troubles and dangers encountered by Lindbergh and his comtemporaries are only avoided by the most meticulous preparations before every journey by air.

After the war it was revealed that at certain times aircraft of the Allied Air Forces were crossing the North Atlantic every twenty minutes. This accomplishment cannot be ascribed solely to progress in aircraft construction. New paths had also been explored in many ancillary fields—radio technology, meteorology, study of the upper atmospheres, etc. All this war-time experience, gained at the risk of human lives, is today at the disposal of civil aviation. At the same time efforts have been made to cut down considerably the possibility of piloting errors by the development of automatic pilots, radio navigational aids, etc.

All the same it is a fallacy to think that all the aircrew has to do is to watch these devices which seem so mysterious to the layman, and that there is less responsibility and effort required today than there was in the time of the first pioneers.

What Colonel Lindbergh succeeded in doing in 1927 can only be compared remotely with the results that an international ground organization in scheduled airline operations makes possible today. *Collaboration between the ground organizations of the countries interested in air transport*—a coordination which PICAO is striving to perfect—*and the aircrews* is the basis for safe and efficient air transport operation.

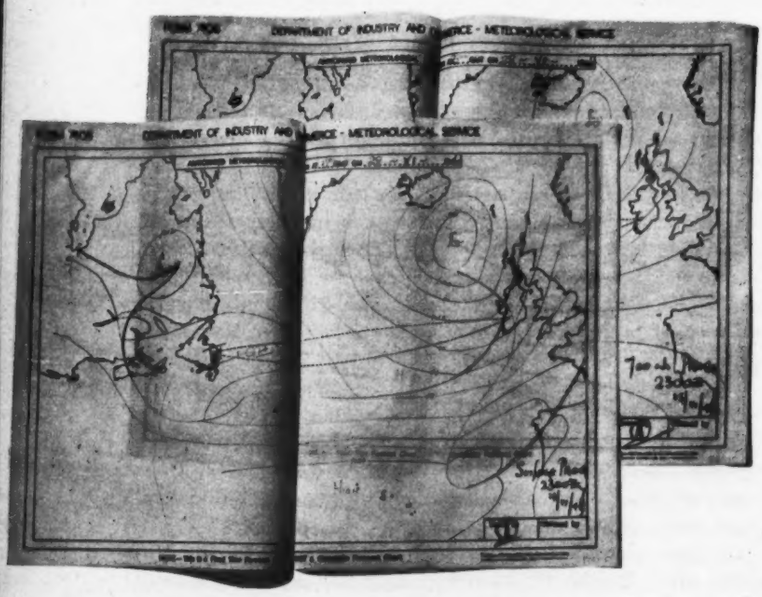
* * *

To show the details of this collaboration is the subject of the following lines. *As example is taken a crossing of the North Atlantic from Europe to America*, such as is made daily by numerous airline companies at the present time.

All these companies are operating exclusively four-engined airliners: either Douglas DC-4's developing 6,000 H.P. with take-off weight of 40 tons, or Lockheed "Constellations" developing around

The *crew* of a trans-Atlantic airliner at work.

8,800 H.P. with maximum all-up weight of 45 tons. The number of passengers which these aircraft can carry on lengthy flights, such as trans-Atlantic crossings, is largely contingent on the amount of fuel to be carried. This is again fixed to a large extent by weather conditions, such as head winds, bad weather areas, etc., on the route. However, a definite flight plan cannot be established until complete weather reports and forecasts have been obtained, with the consequence that feverish activity takes place amongst the aircrew and ground staff at the airport of departure some two hours before the scheduled take-off time. Normally on all important airports a representative of the airline company provides the liaison between the aircrews and the airport staff, and is responsible for the airport ground organization side of the preparations for the departure of aircraft. He acts as his company's flight superintendent and arranges the co-operation of his aircrews with the various airport departments such as maintenance, met. office, and radio room for the drafting of the flight plan.



Weather maps provide the basis for the preparation of flight plans.

The aircrew, which normally consist of the captain, co-pilot, navigator, radio officer and flight engineer, splits up to carry out the various specialized jobs in hand. In principle the two pilots work in collaboration with their flight superintendent, while the flight engineer discusses his tasks with the chief maintenance engineer, the navigator with the chief weather officer, and the radio officer with the radio staff.

Our specific example is *a flight from Shannon, Eire, to Gander, Newfoundland*, at present the heaviest flown trans-Atlantic sector. The arc of the great circle through these two points, representing the shortest link, measures 1,980 miles. However, flight safety regulations require that several alternative staging posts be designated and, consequently, flight preparations have to be made not only for Gander as destination, but also Stephenville, Goose and Moncton, which are also in Newfoundland. For topographical and meteorological reasons, such alternative airfields are usually located some distance from the designated airport of arrival—in this particular case the additional distance from Gander to Moncton is 540 miles—with the result that safety measures call for an appreciable increase in the load of fuel to be carried. Thus, it is evident that every effort must be made to determine the most favourable route under prevailing conditions, in order to utilize the aircraft's load capacity to the last ounce.

In addition to the experience gained by each airline company in previous flights, weather reports and forecasts form the basis of *flight planning*.

The material supplied by the airport meteorological service consists of:

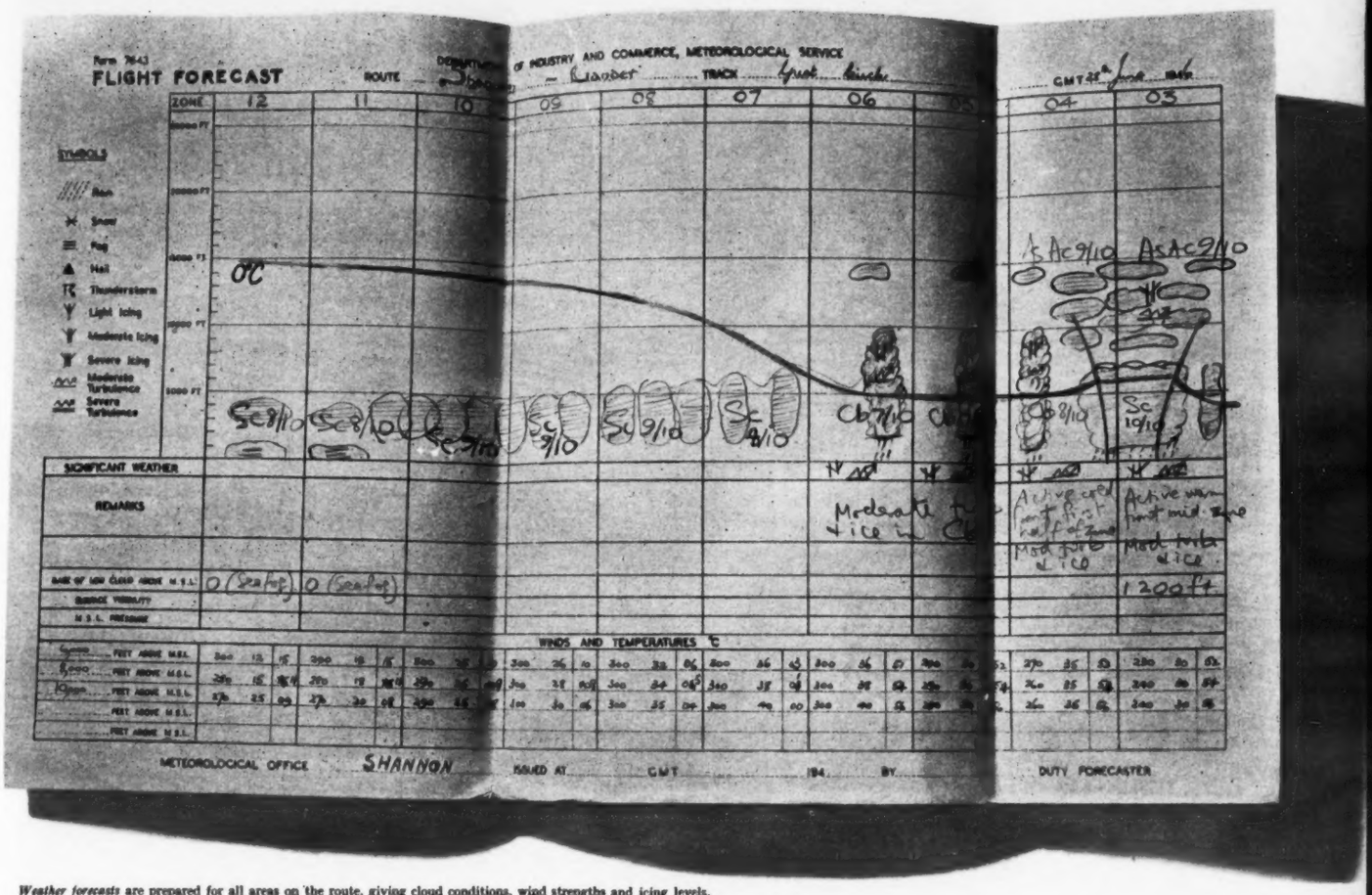
a) A general *weather survey*, that is to say, a weather map for sea level, showing isobars and areas of high and low pressure: predicted changes in pressure are shown on two other maps, one of which is for sea level and the other for an altimeter reading of 2,000 ft.

b) A *flight forecast*, giving local weather conditions likely to be found on each part of the route: the indications here of icing levels and wind strengths at various altitudes along the route are of particular importance.

c) Another form contains weather reports for the airport of departure as well as forecasts for the airport of arrival and alternate airfields: as a trans-Atlantic flight takes some ten hours at the present time, local and en route forecasts have to cover a minimum period of twelve hours.

With the aid of this weather data, the navigator can now work out which areas to avoid because of icing conditions or storms. The wind map allows him to determine a flight path which gives the shortest connection between departure and arrival points and at the same time uses prevailing winds to the greatest advantage. He can determine—purely theoretically—the optimum speed and altitude of the flight, according to the location of favourable wind zones. Thus, should circumstances warrant it, a detour can be made, passing through an area where there are favourable winds, with the result that a lower consumption of fuel is brought about than if the flight were made in a direct line passing through areas of disturbed atmospheric conditions or head winds.

With the help of this route plan may be calculated the ground speed for the flight, in accordance with variations of altitude, climb performance, fuel consumption, etc. Then the captain is presented with a definite *flight plan*, giving the following detailed information as to the way the flight is planned: altitude, speed, true course,

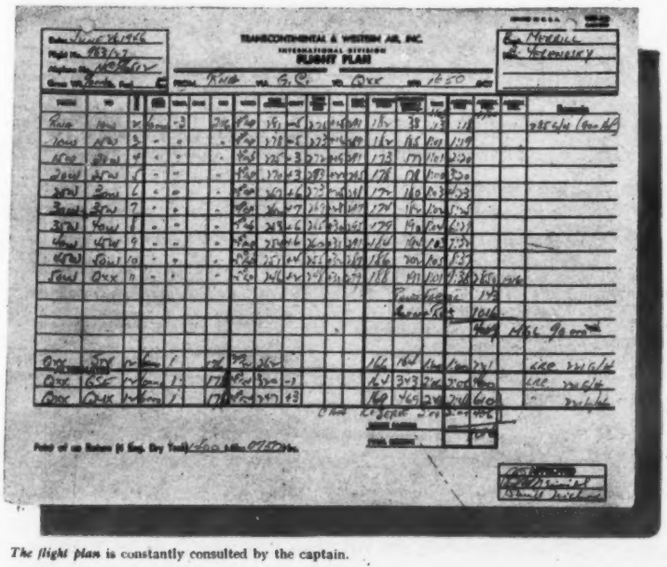


Weather forecasts are prepared for all areas on the route, giving cloud conditions, wind strengths and icing levels.

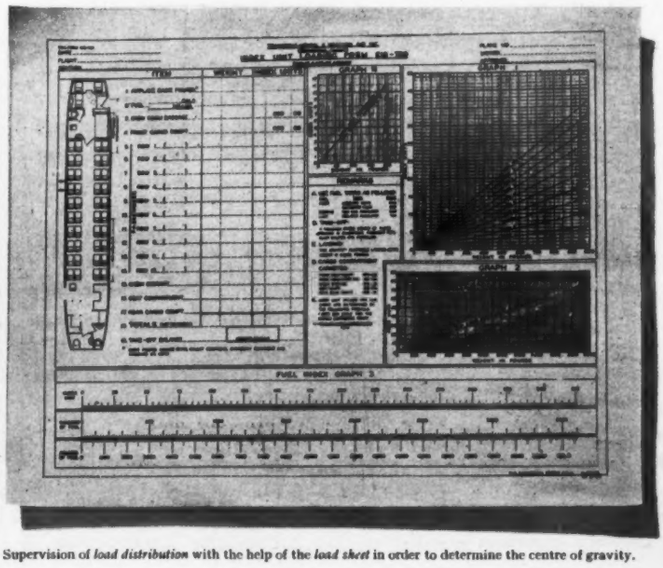
magnetic variation, compass course, duration of flight and fuel consumption. To have a continual check on the amount of fuel available, and flying time remaining, these figures are calculated in advance for each zone of the trip. To the total quantity of fuel resulting from these calculations must be added the minimum reserve required by the U.S. Civil Aeronautics Regulations, that is to say, 5 percent plus another reserve sufficient to give a two-hour flight after the most distant alternative airfield has been reached. Thus, for the flight from Shannon to Gander, consumption has to be worked out not just to Gander, but to Moncton, plus an additional two hours' flying time.

The flight plan for the Shannon-Gander leg includes the following provision for fuel: 10 flying hours with a fuel consumption estimated at 2,850 gallons, to which is added: 5% extra—143 gallons; fuel necessary for the flight from Gander to Moncton at the most economical speed—approximately 610 gallons; and a reserve for two extra hours of flight—406 gallons: hence, a total of approximately 4,000 gallons.

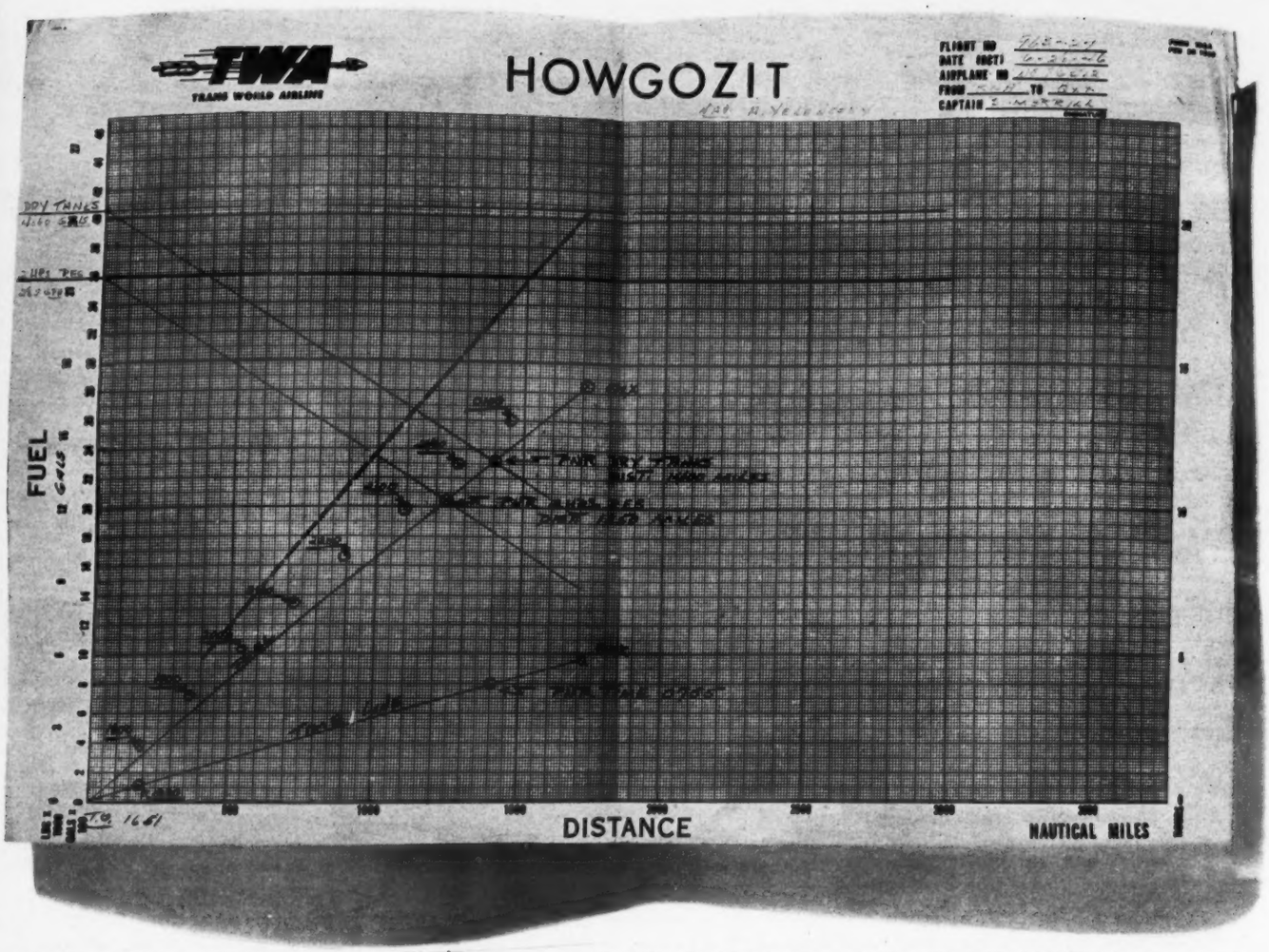
It is only after the captain of the aircraft has approved and signed this flight plan that the airline company's flight superintendent can work out the *load sheet* for the aircraft. In doing this, he has to cal-



The flight plan is constantly consulted by the captain.



Supervision of *load distribution* with the help of the *load sheet* in order to determine the centre of gravity.



The *"howgozit"*, which gives a graphic picture of the fuel consumption, containing the danger line (dotted) and, beneath it, the pre-calculated consumption curve and the horary line. Actual consumption data are entered hour by hour and in this case lie just above the pre-calculated values.

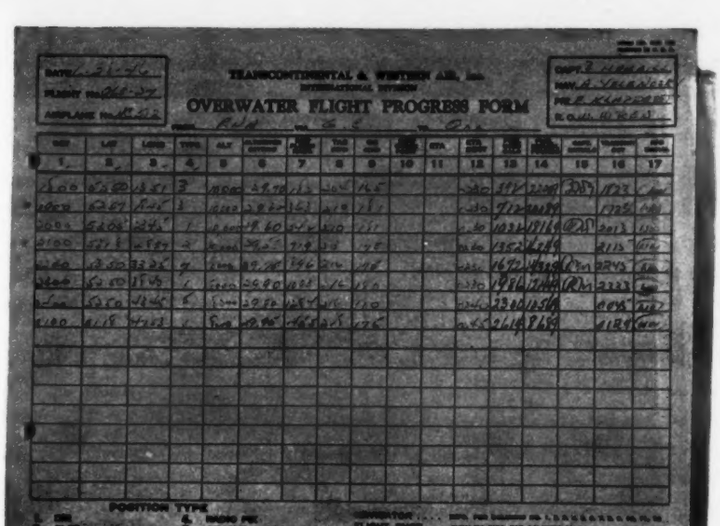
culate the payload available for passengers or freight. The theoretical load capacity of the aircraft is determined automatically by the maximum permissible take-off and landing weights, but, however, as in each aircraft the centre of gravity must lie between determined limits, the commercial load must be scientifically distributed. To simplify calculations in this connection, a special form exists which takes all loads into consideration and contains graphic tables from which the distribution of the load and the position of the centre of gravity can be worked out.

This load sheet, which has also to be presented for signature by the captain as it gives him an idea of the probable behaviour of the aircraft during the take-off, naturally cannot be made out until just before the departure, once the weather reports have been supplied. Thus, should unexpectedly strong headwinds have to be taken into account, it might be necessary at the last minute to reject passengers who had already booked, or else to cut down their baggage considerably.

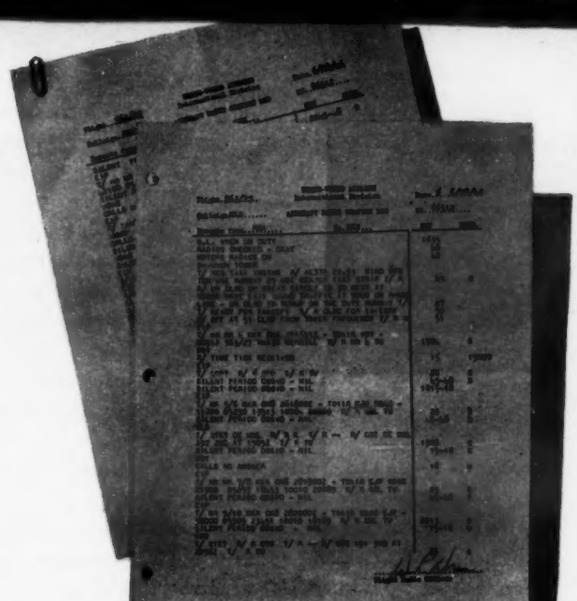
Even with all this, the preparations for a trans-Atlantic flight are still not complete. In order to ensure that at all times during the flight *an exact check on distances and fuel consumption* is available, a graphical representation of this data is contained in the so-called "Howgozit. Not only showing a curve representing estimated fuel consumption for the flight, it also has a red danger line indicating the minimum amount of fuel which must be in the tanks for each zone of the trip. It is especially useful after the point has been reached when it is no longer possible to turn back to the airport of departure. On such occasions as unanticipated bad weather developments, it enables the captain to decide at the latest possible moment how to alter his flight plan. Actual fuel consumption—alongside the predicted consumption—is then continously plotted by the captain and navigator on this graph. Should the actual fuel consumption curve approach the danger line, it would be immediately understood that the flight could no longer be carried out in accordance with the original flight plan.

The choice of a specified route enables the radio officer to make preparations for *radio communications* during the flight. For this, he has first to consider with which ground stations he desires to communicate; he has to take care of the establishment of an accurate list of the frequencies of all ground stations, radio beacons, etc., concerned. In addition, he has to check up not only on the position of all weather ships which the Provisional International Civil Aviation Organization is making available for the safety of trans-Atlantic flights, but also on the time-tables of steamships passing near to the route of the flight. It is true that, normally, he does not need to communicate with the latter, but knowledge of their positions would enable him to make an eventual emergency landing in the vicinity of one of these vessels.

Termination of all these tasks is effectively the signal to prepare the aircraft for take-off; a final check is given to the instruments, radio equipment and automatic apparatus. Then the multitude of paper formalities has to be contended with: forms to be filled in for the immigration authorities, customs officials and sanitary authorities. The captain is personally responsible for the completion of all this official paraphernalia. At last the *"right-away" signal* is given.



Hourly *position reports* are constantly recorded.



All radio messages transmitted and received have to be recorded continually.

The radio station on the airport of departure gives the crew exact instructions as to direction and altitude to avoid all danger of collision at take-off. The aircraft then signals its departure and "takes to the air".

From the very *beginning of the flight* the essential task of all members of the crew is as accurate as possible *adherence to the flight plan*. As the flight plan is established from weather reports and forecasts, the actual meteorological conditions are constantly observed during the flight, so that a change of route can be made in good time if unexpected bad weather is encountered. At the same time, additional weather reports are demanded during the flight in order to make up for any discrepancy in the forecasts.

Observations in this connection are currently noted on a form prepared in advance, which is given to the meteorological office after the flight. In this way, valuable data are collected, which can be put to good use in the improvement of successive reports.

For his part, the flight engineer calculates from his instruments the output developed by the engines, the fuel consumption and the amount of fuel remaining at all times. All these observations are noted and entered—alongside information furnished by other crew members—hour by hour in the *flight progress forms*. Particularly important entries are the estimates of position established by the navigator and radio officer. As there is no possibility of making a visual check on position during flight, the crew is forced to rely for the greater part

The flight engineer at work.

Navigator's compartment.

on data supplied by radio bearings, radio goniometry or astro-fixes. Should it be possible to do so, however, an approximate check can be made when weather ships, or liners following a predetermined route, are sighted, but this method does not give an accurate position. As the accuracy of the position varies according to the method of radio bearing, the information periodically transmitted to ground stations must not only include positions calculated in latitude and longitude, but also the method used in their determination. Already at the present time various airline companies are using—temporarily for test purposes—radar navigational systems developed during the war (Gee, Loran, Consol, etc.). The flight progress form or log book, gives the captain all the information he needs for piloting and continuation of the flight. All values from which may be derived the distance flown and the amount of fuel consumed are plotted on the "Howgozit", so that the captain can determine at all times whether the fuel consumption for the specifically selected engine power corresponds to the pre-calculated data, and if the fixed limit for an eventual return can be crossed without danger.

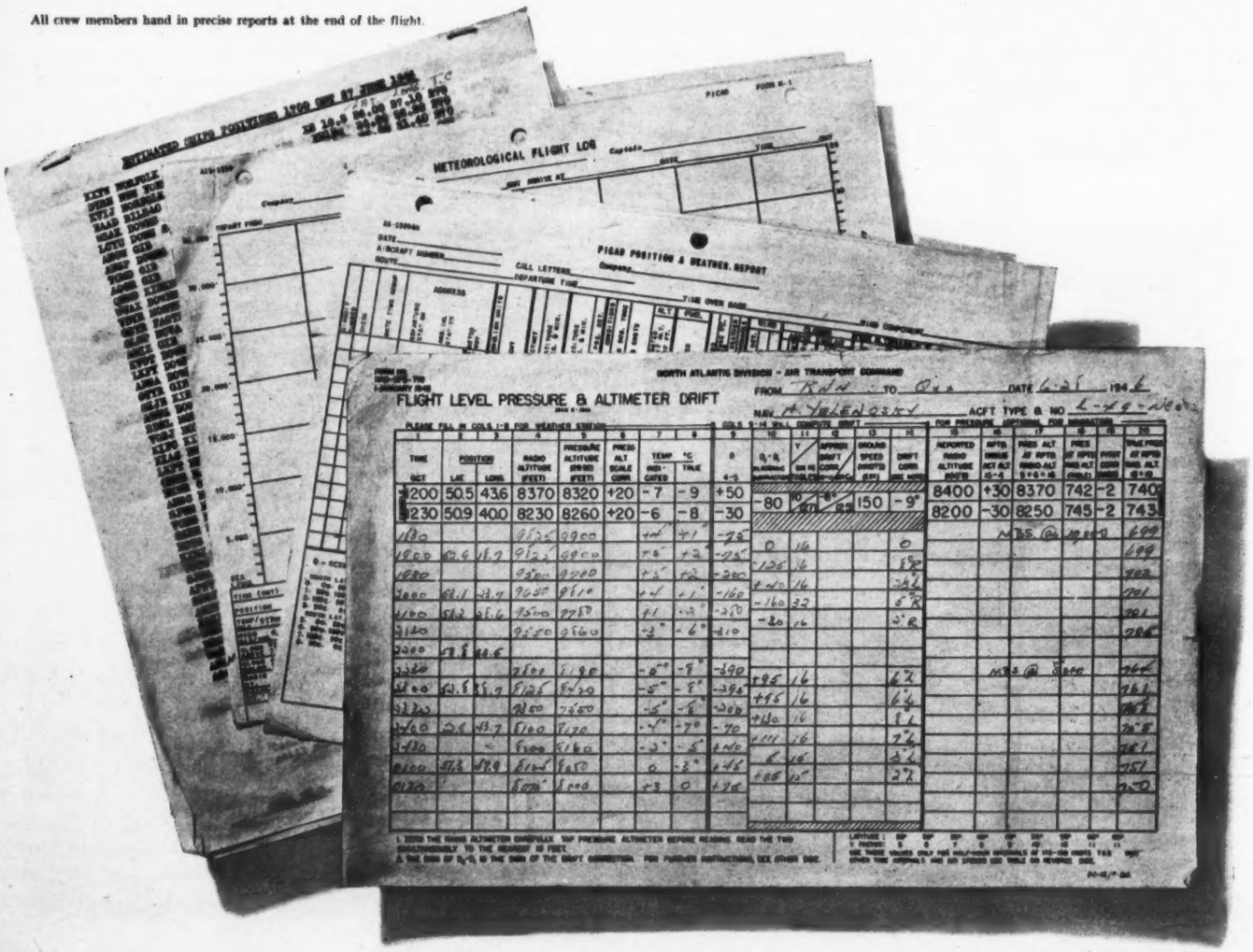
During an entire trans-Atlantic flight, *radio* is effectively the sole link between aircraft and ground. To avoid all possibilities of this link's being severed, the airborne radio equipment usually consists of two complete and independent sets. Usually installed are two transmitter-receivers working on a frequency range extending over 200 to 18,000 Kc., two high-frequency transmitter-receivers and the necessary instruments for blind-landings (see Interavia, Review of World Aviation, No. 8/9, November/December, 1946, page 63). This radio equipment is amply sufficient to cope with practically any length of sector one may wish to fly during a trans-Atlantic crossing.

All information transmitted or received by radio is noted in the *flight radio log*, which afterwards serves as a record to show that the obligatory announcements of position have been effected. PICAO requirements demand that the altitude and the remaining supply of fuel be reported as well as position. In this way, ground stations are constantly in possession of the means to detect whether the flight is running to schedule, or if a change in route or airport of arrival, or even a return of the aircraft to the airport whence it took off, is to be expected. Besides transmitting periodical reports, the radio officer is required to inform the ground station immediately if any deviation from the flight plan reveals itself to be necessary, and also of any special developments in the weather, the knowledge of which could prove of importance to other aircraft.

As soon as the aircraft enters the area under the control of the *airport of arrival*, it receives instructions in accordance with the weather situation and landing demands at the field. Should the ceiling be low and several other aircraft orbiting prior to receive final permission to land, then the landing must be executed in accordance with C.A.A. prescriptions. If weather conditions do not allow for a landing at the designated airport of arrival, the aircraft is diverted to one of the pre-selected alternative airfields.

Landing at the airport of arrival by no means denotes that the work of the crew is over. After the usual customs formalities begins the task of evaluating data furnished during the flight; moreover,

All crew members hand in precise reports at the end of the flight.


METEOROLOGICAL FLIGHT LOG
PICAO POSITION & WEATHER REPORT
NORTH ATLANTIC DIVISION - AIR TRANSPORT COMMAND
FLIGHT LEVEL PRESSURE & ALTIMETER DRIFT

the various reports have to be prepared for transmission to the statistical departments of the airline company, the aviation authority in question, as well as to the weather and radio stations. Each member of the crew prepares a report on his own activity during the flight. The radio operator notes down his communications with the different stations, his comments on the functioning of the radio equipment and any suggestions he might care to suggest for future improvements in this regard. The same applies to the flight engineer who, with the help of his notes, makes up a report on all irregularities in the functioning of the engines and accessories, and attaches a list of all maintenance or repair work that he has performed during the flight. He then transmits this information to the maintenance department and points out any particular maintenance or overhauls that he considers ought to be added to the existing procedure. One of his most important tasks is to inform his company of any defects in the functioning of the equipment and to submit his own proposals for improvement. The *journey* log is the official aircraft log. It is maintained by the navigator and contains an exact description of the route followed and the airports visited. Signed by the captain and accompanied by the passenger list, it is presented to the customs and immigration authorities as an official record of the aircraft's passage through the different countries.

* * *

The above description gives a general idea of how a trans-ocean flight is prepared and executed.

Air transport of today does not have to contend with the risky aerial ventures of Lindbergh's era, as may be concluded from this account of the careful preparatory work which precedes each flight, and in the precision work of which lies, perhaps, the aircraft's destiny. During the actual flight, it is the teamwork of the aircrew which counts to the greatest extent.

The preparation and execution of the flight, as will have been discerned, demand a wide-spread division of work between the various crew members, each a specialist in his own particular field. As head member of the crew, the captain does not need to concern himself with matters of secondary importance and, as a rule, he may confine himself to supervising the work of this subordinates. But, nevertheless, it requires a tremendous effort on his behalf to maintain constant and sustained vigilance during an entire flight of ten hours or more. By no means can his assignment be compared with that of the captain of a luxury liner, who, in good weather, merely fulfils the rôle of "social host".

The strict limitation of the number of hours to be flown each week and the appropriate rest periods accorded to crew members were by no means decided upon arbitrarily or accidentally. On the other hand, psychological and physiological strain which these men must support over prolonged periods finds its reward in the relatively high salaries paid. Though these salaries can become an excessive burden to an airline when union organizations are involved—Transcontinental & Western Air were recently near to bending at the knees under it—one is bound to concede that flying personnel deserve higher pay than employees of surface transport concerns. For despite astounding mechanical improvements in flying equipment and the adaptation of ingenious automatic devices, it is in air transportation more than in any other form of commercial conveyance that the destiny of passengers lies in the skill, alertness, conscientiousness and determination of a captain and his crew.

Bi.

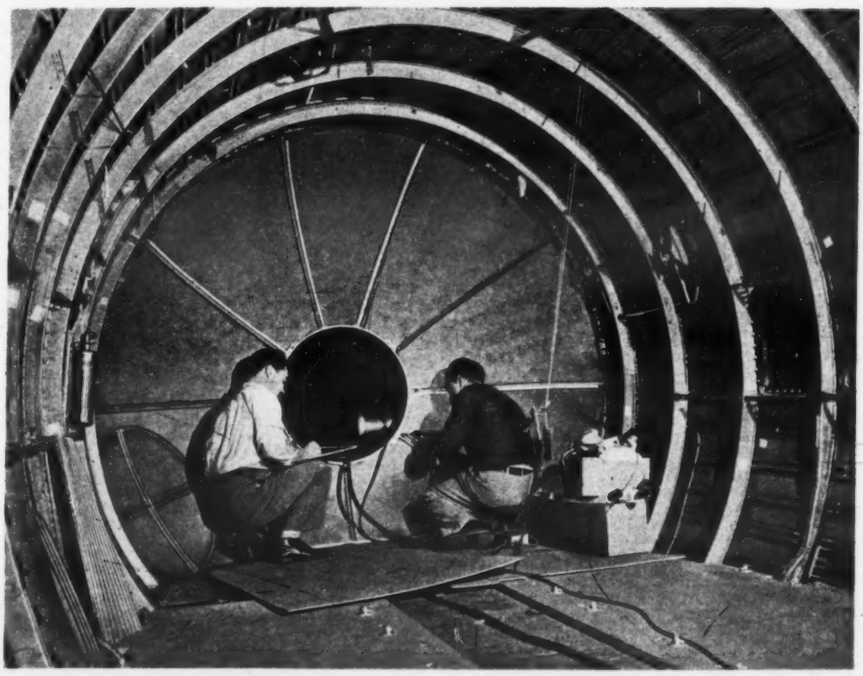
DOUGLAS DC-6

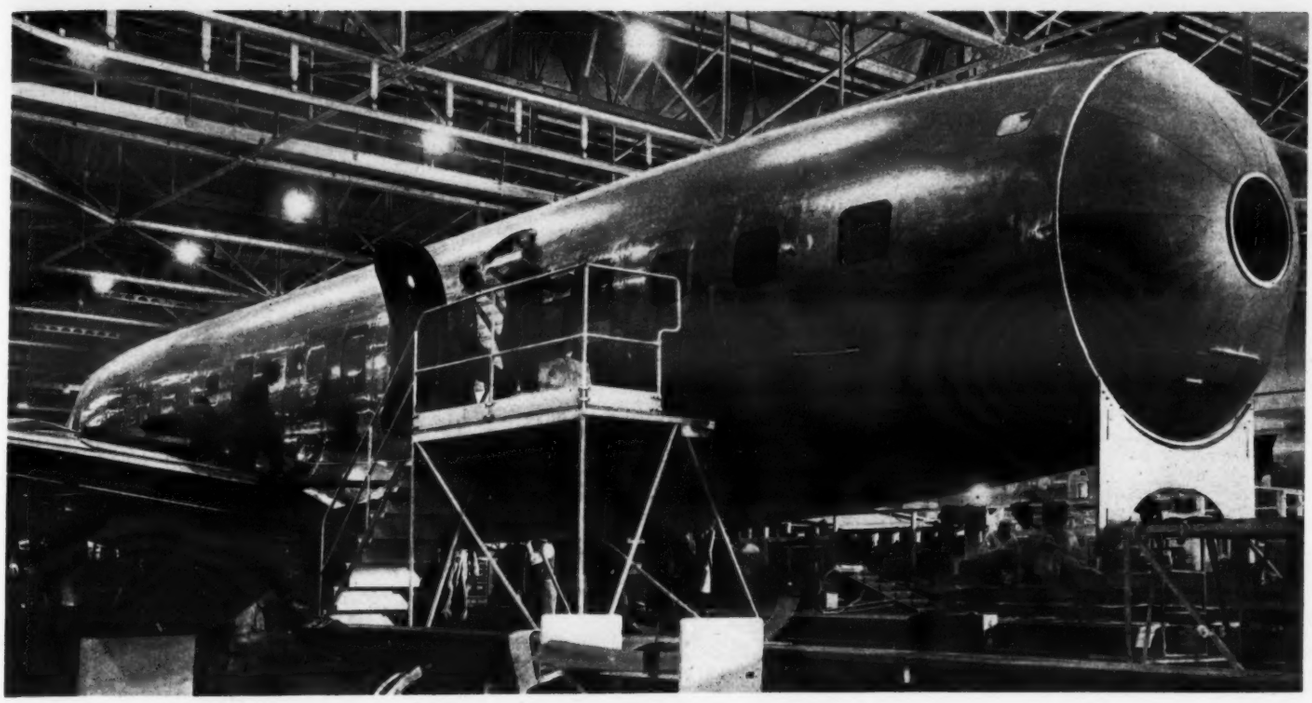
As youngest member of the family of Douglas commercial transport aircraft, which already before the war made themselves a name with the DC-2 and DC-3 twin-engined models, the Douglas Aircraft Company of Santa Monica, California, presents a new four-engined airliner, the *Douglas DC-6*.

It is not to be doubted that it will uphold the famous tradition of its predecessors. The standard arrangement of the DC-6 can accommodate 52 passengers; each group of four seats can be converted into a berth so that, together with the folding upper berths, sleeping accommodation is available for 26 passengers. Optional arrangements include one for short-line traffic carrying 68 passengers, a slightly roomier one fitted with 58 seats and, finally, a lay-out primarily for trans-ocean flying with accommodation for 50 passengers by day and 26 by night. The following description concerns the standard arrangement, whereby weight and performance figures are in accordance with data supplied by the manufacturers and do not take into consideration the recent increase in gross weight.

Powered with four 2,100 H.P. Pratt & Whitney air-cooled eighteen-cylinder twin-row radials, the DC-6, manned by a crew of five , transports a payload of 14,280 lbs. at a cruising speed of 306 m.p.h. over a distance of 1,600 miles.

Equal in dimensions to that of the DC-4, the metal wing features a span of 117 ft. 6 in. and an aspect ratio of 9.44. Wing flaps and control surfaces are likewise of all-metal construction, as well as the trimming tabs. Contrary to other manufacturers of all the latest types of American commercial aircraft, such as the Lockheed "Constellation" and Republic "Rainbow", Douglas have not incorporated an oleo-hydraulic servo system in the DC-6 to assist control response. The pilot's manœuvres are conducted directly to the Flettner tabs of the control surfaces. Despite the size of the aircraft, careful aerodynamic balancing and extensive reduction of control system friction has achieved easy responsiveness of control over the whole speed range. Besides eliminating the possibility of a breakdown caused by an auxiliary boost system, this purely mechanical method of control also enables the pilot to "feel" the aerodynamic forces acting upon the aircraft.



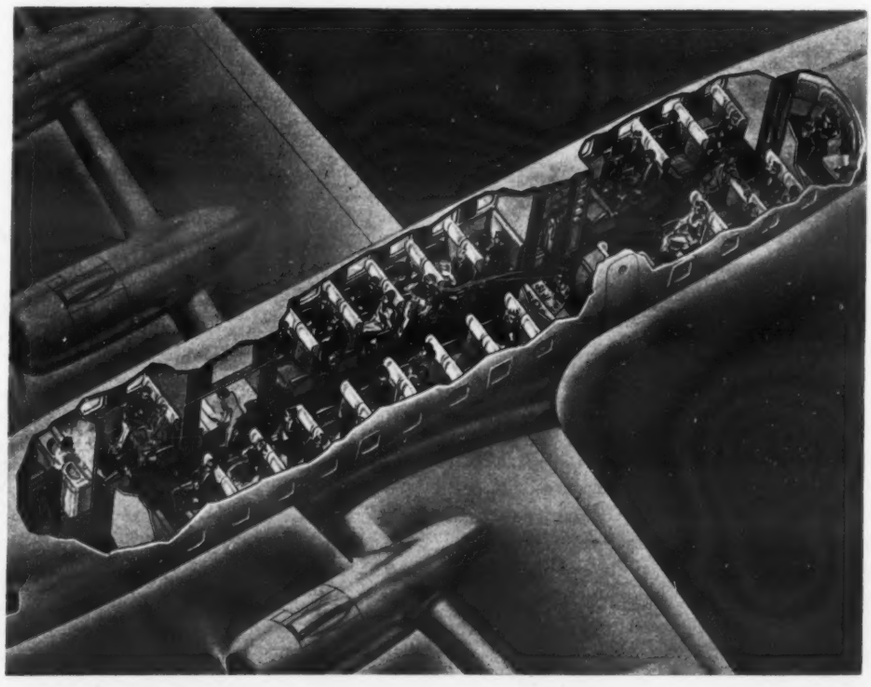


The double-slotted wing flaps possess a span of 29 ft. 6 in. and a total area of 229.4 sq. ft.; full-span landing flaps were not incorporated —presumably in order to achieve the greatest possible resemblance to the DC-4 wing. The ailerons occupy the total span of the wing outer sections, measure 23 ft. 4 in. and both together possess an area of 81.1 sq. ft.

The *fuselage*, of monocoque construction, is of nearly circular section and can be pressurized over the whole length so as to provide sea-level pressure up to 9,000 ft. and that of 8,000 ft. at an altitude of 20,000 ft. The supercharged section of the fuselage commences fore of the flight deck and terminates at the junction of the vertical stabilizer, the forward and rear limits being hemispherical in shape. The cabin pressurizing system of the DC-6 is fully automatic and also adjusts itself to changing conditions brought about by unexpected deviations from the flight plan. With it is combined an air-conditioning system which, by means of an automatic thermostatic control arrangement, maintains all sections of the cabin at desired temperatures within a tolerance of 3° F. As the problem of circulating ventilating air was never completely solved in the conditioning plant hitherto used in airliners, Douglas chose to develop a new system for the DC-6. Fresh air is conducted in flight direction beneath the central aisle, simultaneously warming or cooling the floor and wall panels, and enters through grills at window height. It leaves the cabin through openings in the walls situated just above floor level. In order that the air-conditioning system may also be operated when the aircraft is on the ground, the DC-6 is equipped with special blowers which are fed by the batteries when the engines are not running.

The division of the DC-6 *cabin* bears witness to an effort towards achieving the last word in comfort in the available space. Contrary to the round windows usually featured in aircraft with supercharged cabins, those of the DC-6 are rectangular and unusually large: 24 in. by 16 in. The ceiling height of the cabin measures 7 ft. Directly aft of the cockpit and a luggage compartment is a spacious men's lounge containing three washbasins. The rear fuselage contains a luxuriously-appointed ladies' lounge. The intermediate space is divided at the level of the entrance door and forms a forward compartment for 36 passengers and a smaller room at the rear for sixteen passengers. Between them are cloakrooms and stowage for light luggage, and the facilities for stewardess service.

Hydraulically adjustable, the seats are exceptionally wide, each passenger being allotted 21 in. Four seats form a berth of 42 in. in



width and 76 in. in length. The upper berth, 36 in. by 78 in., can be made up before the take-off and folded against the wall. Each berth has a window, an accessory cabinet with mirror, make-up kit for ladies or shaving kit for men, an ashtray, clothes hangers, a reading-light, etc.

The all-metal cantilever single *empennage* had to be slightly re-inforced after the first trial flights, as the stressed skin revealed certain permanent deformations. The span of the horizontal tailplane is 46 ft. 6 in. and the total area 365.6 sq. ft. (108.8 sq. ft. of which is elevator area). The total area of the fin and rudder unit is 159.9 sq. ft., which includes 49.0 sq. ft. for the rudder. *Anti-icing* in the DC-6 comprises three air-heaters, two of which serve to heat up the wing leading-edge and warm the whole wing, the third heater protecting the tailplane surfaces. The heating system is under direct control of the pilot, who can regulate its functioning by appropriate fuel dosing. For the wing, the air intakes are situated between the two engine nacelles of each panel, and in the leading-edge of the fin for empennage de-icing. In the case of Hamilton Standard Hydromatic reversible-pitch airscrews, airscrew blade de-icing is accomplished with alcohol, with the containers housed in the wing roots; Curtiss Electric reversible-pitch airscrews do not require this system as electrical resistance "boots" are fitted to the leading-edge of each blade.

The *cockpit* of the DC-6 is extremely roomy and there is easy access to the instruments and control levers, a large number of which are situated above the windscreen. Particular value is attached to instrument illumination, whereby red light is used throughout in order to eliminate all possibility of reflection at night. Thanks to completely automatic equipment for engine control, airscrew synchronization and cabin pressurization, it was not found necessary to incorporate a separate station for the flight engineer in the DC-6. A further innovation which may be mentioned is the adaptation of mechanical

gust locks to the rudder, elevator and ailerons, which eliminate all possibility of gusts' causing damage to the control surfaces when the aircraft is on the ground. Lastly, the DC-6 is the first airliner to offer the means of coupling the aircraft telephone system to land telephone lines while on the ground, thus enabling crew members and passengers to put urgent long-distance calls through from the the machine.

The *tricycle landing gear* of the DC-6, developed from that of the C-54 "Skymaster" military transport, is provided with an additional safety device which makes it impossible to retract the undercarriage as long as as any weight remains upon it. The dual main wheels, fitted with two independent sets of oleo-hydraulic brakes and an additional air braking system for emergencies, possess a track of 24 ft. 8 in. and a wheel base measuring 31 ft. 1 in. The nose-wheel may be steered by means of a small steering wheel to the left of the pilot's position, enabling the aircraft to be turned about a radius of approximately 33 ft.

The *power plants* of the DC-6 may be dismounted and changed within 30 minutes together with all accessories; each engine is designed so as, when removed, to embody all necessary elements to permit ground testing prior to re-installation. Thrust from the engine exhaust gases are used to increase speed, whereby the discharges are in every case located on the outboard sides of the nacelles in order to reduce noise in the cabin. In order to reduce fire hazards, all critical parts of the engine sections and nacelles are of stainless steel; in addition, the accessory sections are tightly sealed and can be flooded with CO_2 in case of emergency. Additional fire detection systems are located in the nacelles and baggage compartments.

Cargo stowage facilities comprise two pits beneath the cabin floor, fore and aft of the wing roots; both are entered by doors measuring 45 in. by 57 in. The capacity of the forward hold is 203 cu. ft. and of the rear one, 171 cu. ft. In the case of a freight consignment of average density, these correspond to weight capacities of 2,840 lbs. and 2,390 lbs., respectively. In order to facilitate loading and unloading of cargo, each hold contains four separate aluminium-alloy baskets, 34 in. wide, 26 in. deep and 72 in. long, which are suspended from longitudinal rails. The pre-

loaded baskets are then transferred mechanically, thus avoiding loss of time during short intermediate stops.

MAIN DIMENSIONS

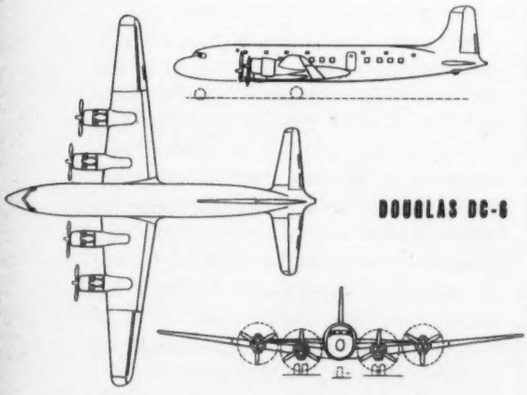
Span	117 ft. 6 in.
Length	100 ft. 7 in.
Height	28 ft. 8 in.

FUSELAGE

Maximum width	125 in.
Maximum depth	138 in.
Overall height	17 ft. 3 in.

Compartment volumes:

Cockpit	180 cu.ft.
Forward entrance	208 cu.ft.
Forward luggage hold	144 cu.ft.
Forward lounge	268 cu.ft.
Forward cabin	2,135 cu.ft.
Cloakroom, buffet and entrance	354 cu.ft.
Rear cabin	882 cu.ft.
Rear lounge	262 cu.ft.
Forward cargo pit	203 cu.ft.
Rear cargo pit	171 cu.ft.



WING

Total area	1,463 sq.ft.
Root chord	228.8 in.
Tip chord	71.3 in.
Airfoil section (root)	NACA 23016
Aspect ratio	9.44
Dihedral	7°
Angle of incidence (root)	4°
Angle of incidence (tip)	1°
Aileron area	81.1 sq.ft.
Aileron span	23 ft. 4 in.
Flap area	229.4 sq.ft.
Flap span	29 ft. 6 in.
Flap down-travel	50°

TAILPLANE

Horizontal surfaces:

Span	46 ft. 6 in.
Total area	365.6 sq.ft.
Stabilizer area	210.9 sq.ft.
Effective elevator area	108.8 sq.ft.

Vertical surfaces:

Total area	159.9 sq.ft.
Fin area	93.4 sq.ft.
Effective rudder area	49.0 sq.ft.

LANDING GEAR

Track	24 ft. 8 in.
Wheel base	31 ft. 1 in.
Min. turning radius	33 ft. 6 in.

POWER PLANT

Pratt & Whitney . . . . . Double Wasp CA15

Take-off power (1st speed)
2,100 H.P. up to 3,000 ft.

Take-off power (2nd speed)
1,700 H.P. at 10,000–16,000 ft.

Rated power (1st speed)
1,800 H.P. up to 6,000 ft.

Max. continous power (2nd speed)
1,600 H.P. at 16,000 ft.

Airscrew diameter	13 ft. 1 in.

WEIGHTS

Max. take-off weight	84,000 lbs.
Max. landing weight	73,000 lbs.
Empty weight	48,917 lbs.

FLIGHT PERFORMANCE

Max. speed at sea level	305 m.p.h.
Max. speed at 10,000 ft.	331 m.p.h.
Max. speed at 19,000 ft.	344 m.p.h.
Cruising speed at sea level	264 m.p.h.
Cruising speed at 10,000 ft.	288 m.p.h.
Cruising speed at 19,000 ft.	301 m.p.h.
Service ceiling (4 engines)	26,300 ft.
Ceiling (3 engines)	16,800 ft.

C.A.A. field length requirements:

Take-off (max. take-off weight)	
sea level	5,070 ft.
5,000 ft. altitude	7,220 ft.
Landing (max. landing weight)	
sea level	4,840 ft.
5,000 ft. altitude	5,790 ft.

The situation of the Douglas Company and the impending competition between the two trans-ocean airliners are outlined elsewhere in this magazine (see page ...), where the comparison presented between the DC-6 and the Lockheed "Constellation" concern the MC-2 version of the DC-6, only recently announced. The differences in numerical data clearly illustrate the variations to which a new aircraft can be subjected during trials. *Bi.*

RAILS VERSUS WINGS

A Civil War in American Transportation

By Dr. Ernest C. Steefel

"In cold or heat or snow or rain
You get there when you go by train!"

With this ditty a large American railroad appeals to the "seasoned traveller" to "go by train in all seasons". The airlines answer that weather difficulties will be largely overcome as soon as the use of radar and other electronic devices make instrument landing routine no matter how thick the fog or how low the ceiling.

The airlines attack the railroads with such slogans as:

"Compare the fare,
You'll go by air!"

to dispel the misconception that air travel is still expensive.

Such advertising compaigns highlight the competition between American railroads and airlines.

Having steadily and systematically reduced their fares, the airlines can now confidently point to about 150 important examples where it is cheaper to go by plane than to take a Pullman with lower berth, such as from Washington to Boston. Only in little more than a dozen instances are new passenger airline fares above rail rates plus lower berth, reaching $13 for the trip from San Francisco to Miami, for example. But, as of November 1st, 1946, there were four major trips in the West of the United States where air travellers saved over $10 compared to taking a lower berth on the train:

	Savings:
Denver to San Francisco	$12.65
Seattle to Denver	$12.08
Seattle to Oklahoma City	$11.53
Spokane to Los Angeles	$10.21

When the airlines first started carrying passengers on regular schedules, the tariff was about twelve cents a mile. Now it averages about 4½ cents a mile. Rail distances are on an average about eighteen percent higher than the "crow-flying" routes of planes. Hence, put on the same basis, the plane charge is about four cents per rail-mile.

Many of the arguments also point to the future, with both the railroads and airlines—the latter perhaps somewhat hastily—laying the stress on comfort.

At a recent special railroad exhibit in the Department of Commerce in Washington, a "threedex" coach was shown with opportunities for first "dex" passengers to ride sideways and top "dex" passengers to ride facing forward, with cardrooms for middle "dex" passengers. There were duplex roomettes each with a solarium-sized window, full-length disappearing bed, individual control of heating, lighting' ventilation and air conditioning. There were three-tier sleepers. There were dining cars with tables cut diagonal to make easy swaying down the aisle. Indeed, future trains promise to combine the comforts of a night club, theatre and hotel. Unseen announcers by loudspeaker identify the scenic points of interest and go so far as to list the recovery of lost gloves and umbrellas.

The airlines are not far behind in the promises of enticing comforts. They are stressing huge size—hundred-passenger capacity or more for transcontinental and over-ocean trips. They predict greater speed—300 or more miles per hour. They promise more frequent schedules—like a trolley car with no reservations needed—and dangle before the public eye promises of such refinements as luxury berths, sleep-inducing seats, cocktail lounges, telephone service, radios, air conditioning, altitude-defying pressurized cabins.

The airlines predict planes which will fly 200 passengers from New York to San Francisco between noon at New York and noon at San Francisco—clock-stopping flights, they call them. As a matter of fact, a conventional transport aircraft in service for the American Army covered the 3,323-mile trip from Seattle to Washington in six hours, three minutes and fifty seconds. Only eighteen years ago, in 1927, transcontinental passenger flights required 31 hours and 45 minutes—about five times as long.

The best time which railroads now make between New York and Chicago is seventeen hours, which represents only a three-hour reduction in the schedule of 52 years ago. But the railroads do not evade the speed issue. They say that once they have fully reconverted to peace work, they too will travel faster, making reference to the newest types of train and to the projected super-streamliners pulled by giant Diesel and electric locomotives.

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One may view the matter statistically. The cruising speed of present airliners is 180 miles an hour, but the actual performance averaged for the entire country for a year is only about 115 miles an hour. In the last pre-war year the average train speed was 36 miles an hour, but the "City of Denver" covers the distance between Denver and Omaha at an average train speed of 73 miles an hour. Several crack trains occasionally reach speeds up to 108 miles an hour. The speed of a locomotive can be increased even beyond that, and some have effectively attained speeds of over 200 miles an hour.

However, to equal flying time between Washington and Detroit, for example, a train would have to average 209 miles an hour. Not even the most ardent of rail advocates see that happening in a lifetime and visualize passengers willing to ride the ties at such speed.

The track is the major limiting factor in passenger train speed, and the stupendous cost of improving it is the first deterrent to wholesale modernization of the railroads. There are still only seven rail gateways from the East to the West Coast, and most of the mileage in the Far West is single track. Over thousands of miles of roads, curves would have to be straightened, better approaches led into them, stronger rails, ties, switches and other units provided, heavier ballast used, and signals placed farther apart to provide for greater speed.

According to Department of Commerce figures, replacement of rails and ties alone in the year 1942 cost the railroads 152 million dollars, while maintenance of track structure expense apportioned to passenger service amounted to an equal sum. Besides this, the cost of modern trains is staggering: Two fourteen-car

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streamline trains recently cost a million dollars each; the cost of one new pullman car is now about $107,000. In 1945, railroads reported revenues amounting to 2,082 million dollars, compared to the 578 million dollars of the buses and the meagre 223 millions of the airlines.

That year, however, railroad profits declined sharply. The antidote took the shape of demands for higher railroad freight rates, as airline competition makes an increase in passenger rates out the question. The New York Central Railroad lost over six million dollars in the first nine months of 1946, compared to a net profit of 22 million dollars in 1945. Some fifteen other railroad companies also reported major decreases. The Union Pacific, for example, reported less than 19 million dollars for the first three quarters of 1946, compared to over 31 million dollars during the preceding year; and, Pennsylvania only a little over nine million dollars in 1946 compared to over ninety millions in 1945. On a twelve month's basis, the picture may look somewhat better as tax carrybacks may change deficits into profits.

Speed undisputably remains an effective argument in favour of the airlines, even when related to travelling costs. A comparison between the fastest air and rail schedules between New York and Los Angeles, no tax figured in the fare, but meals included for air, and a lower berth for rail transportation, shows the following:

	Plane	*Train*
Speed in miles per hour . .	135	49
Cost per mile in cents . . .	5.5	4.5

But is has to be taken into consideration that cost to be added for lost business time amounts to only eight hours for the air trip compared to 25 hours by train.

On the other hand, many business men still question whether the speed of air shipment will really pay dividends on many types of cargo. There is virtually nothing that has not been carried by transport planes during the war, from blood plasma to five-ton trucks, but the urgency of victory made red ink seem unimportant on the ledgers. With peace came calculation. Air freight is undoubtedly a growing business, but it grows slower than passenger trade and has its limits. Heavy hauls cannot be envisaged. In this connection, a Western railroad company recently received great applause from railroad circles for an advertising message which emphasized the essential character of railroads for mass transportation and heavy cargo:

"We get rather tired of people (including some airline executives) saying that this is the Air Age and implying that pretty soon there won't be any need for railroads. This is the Atomic Age. Pretty soon there may not be any air, either.

We'd like to see an airplane tote a trainload of oranges from Los Angeles to Chicago, or 5,000 tons of pig iron from Provo, Utah, to Pittsburg, California – or 2,500 tons of newsprint from British Columbia to San Francisco.

For that matter, it would have to be a pretty good-sized plane to accommodate the 500 passengers just one of our streamlined trains carries each day – for a little over a cent a mile. Airplanes have their place and so do trains and trucks and ships.

The advantage of the train is simply this: you can pull more than you can carry. All other forms of transportation are, in effect, carrying their loads in their arms. Only the railroads pull theirs.

We can tie nearly a mile of cars to a single locomotive and roll 5,000 net tons of freight at a crack.

This multiple unit advantage makes a passenger train literally a hotel on wheels, with a dining room, living room, cocktail lounge and comfortable beds to sleep in at night.

So, next time you get into an argument about which is the best – the train or the plane – please don't sell the old 'Iron Horse' short."

The general airline philosophy concedes that *there is plenty of field for each form of transportation where it can give its particular service to the best public advantage.* The Association of American Railroads estimates that, in 1945, of a total of over 990 billion ton-miles of commercial freight traffic, steam railroads carried 688 billions compared to only 88 million ton-miles of the airlines, and of the total 128 billion passenger-miles, steam railroads accounted for 92 billions compared to the air carriers' three and a half. Using somewhat different estimates for 1945 the Air Transport Association of America reports the following development since 1941 in the area of passenger traffic:

	Billions of miles		*Million $ revenues*	
	1941	1945	1941	1945
Railroads . .	25.3	87.0	747.1	2,082.0
Buses	13.6	30.0	231.0	578.0
Airlines . . .	1.4	3.5	97.3	223.0
Total	40.3	120.5	1,075.4	2,881.0

The percent share of the airlines in passenger traffic revenues, after a war-necessited recession from 9 percent in 1941 to about 8 percent in 1945, increased rapidly in the course of 1946, from 10.4 percent in January to 21.6 percent in May.

Seen from a purely economic point of view, airline traffic ought to continue rising sharply in the long haul field, with the airlines progressing towards fulfilment of their promised all-weather flying and, hence, of safety and punctuality. With this, the greater comfort proffered by the railroads would no longer constitute a menace.

EN VACANCES ET EN VOYAGE, POURQUOI NE PAS AFFRANCHIR VOS CORRESPONDANCES AVEC DES TIMBRES SPÉCIAUX? LES DESTINATAIRES LES APPRÉCIERONT CERTAINEMENT

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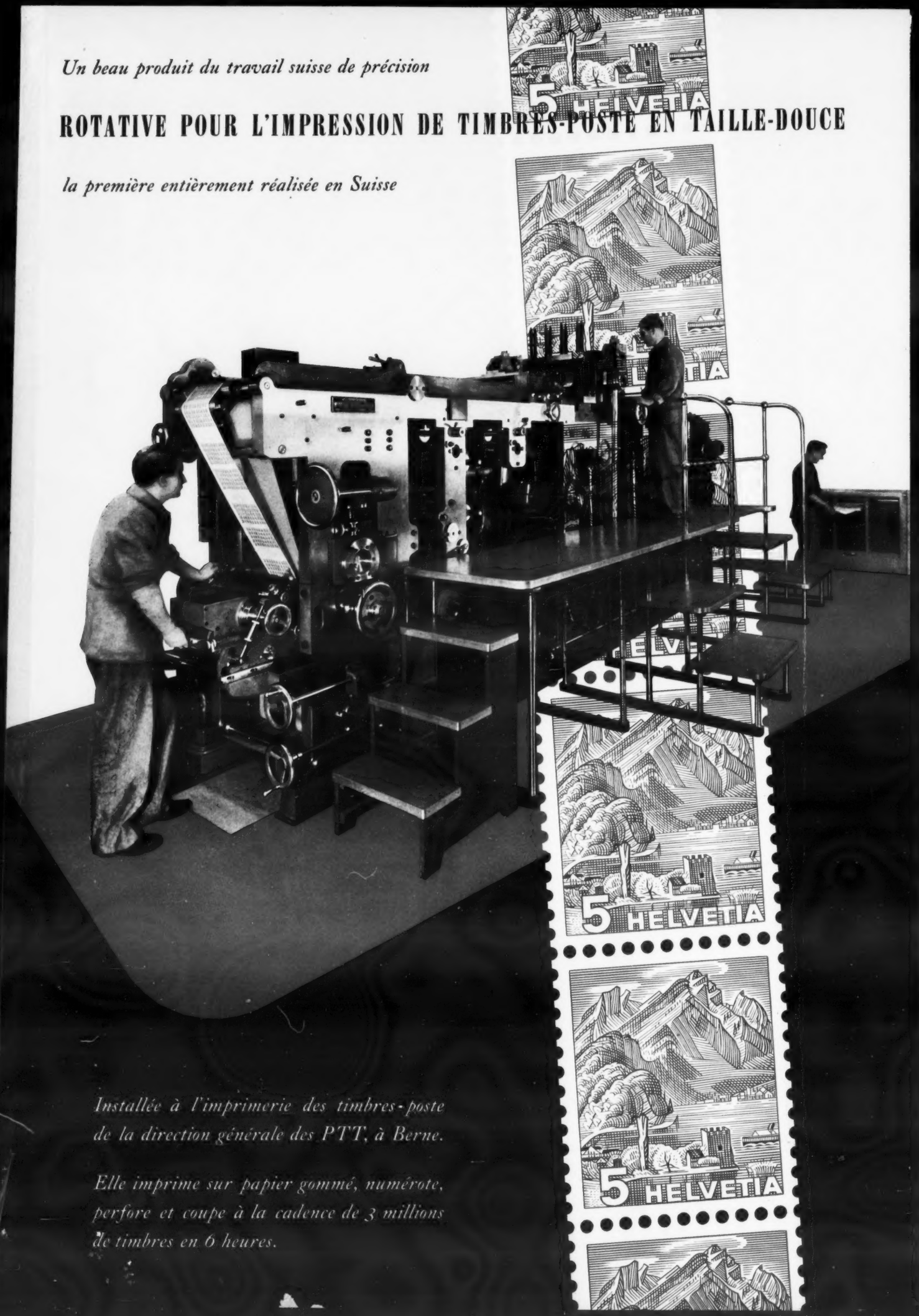

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Television Equipment For Guided Missiles*

Charles J. MARSHALL, Senior Member, IRE, and Leonard KATZ, IRE.

A new method of warfare—for offence, for defence—is upon us. We are fast realising that the guided missile would be the means of waging the war of the future. Quick to recognise these possibilities, the Army Air Forces lost no time in establishing the foundation for a programme of development for this arm. As a part of the endeavour, a television development project was initiated in order to exploit this field.

In searching for a smaller and lighter aircraft television transmitting system, new standards had to be established. Broadcast standards were used where possible, but the following were finally adopted for the military system.

1. Forty frames per second, 350 lines per frame, sequential scanning.
2. Video bandwidth of 4.5 megacycles per second.
3. Vertical polarisation of radiated signal.
4. No DC transmission.
5. Omission of equalising pulses and of serration of vertical synchronising pulse.
6. Synchronising signal equal to approximately 35% of carrier.
7. Double sideband transmission.
8. Wider than RMA standard vertical and horizontal blanking and synchronizing pulses.

The type 1846 iconoscope (similar to 1848) was utilised as the pick-up tube since it was more fully developed for immediate application.

The military standards were chosen after consideration was given to the size, weight, power demand, circuit complexity, resolution and linearity interrelationships.

In the design of the first small television system, known as SCR-549-T1, the previously

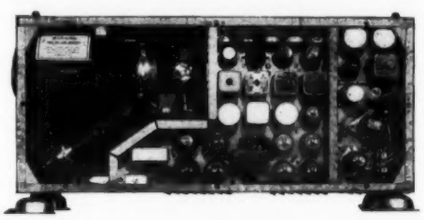

Fig. 1
Interior view of camera-transmitter of SCR-549-T2. All tubes except first video amplifier, high voltage rectifier and final amplifier are shown.

stated characteristics were embodied. With a power output of 15 watts at 100 megacycles, the total weight of the transmitting equipment installed in an airplane (Fig. 1) was approximately 60 lbs. This was less monitor unit and the 14-volt 7-cell storage battery, which weighed 20 lbs. and 37 lbs., respectively. The battery supplied 32 amperes at 13 volts.

Simplifications which were applied to the design of the camera-transmitter unit could not be applied, in general, to the receiver—SCR-550-T1—since the maximum possible sensitivity was needed in order to complement the relatively low transmitter power output. By judicious disposition of components it was possible to build a complete receiver, including the dynamotor power supply, into once case, as illustrated in Fig. 2. For adjusting the performance of the camera-transmitter and for providing an additional picture at the receiving point, a monitor unit (Fig. 2) was designed.

Although most of the receiver design is in accordance with accepted practice, the A.V.C. system deserves special mention in that the A.V.C. rectifier and amplifier operate on the video, rather than on the IF voltage. Thus, compensation is made for the variation in light level and percentage modulation of the transmitter. Another important feature of the A.V.C. system is its low time constant. In airplane to airplane transmissions the field strength at the receiver fluctuates widely from zero to a maximum at a rather rapid and unpredictable rate. The A.V.C. must be capable of following these variations. The receiver weighed 40 lbs. and required 9 amperes at 25 volts.

As a result of flight tests with the *100-megacycle equipment*, it was demonstrated that light weight television equipment was feasible for use in guided missiles. These sets, however, had a number of inherent limitations which made their use as a military equipment undesirable, and it became necessary to formulate new specifications as to performance and operation.

The performance limitations which ruled out further use of the 100-megacycle equipment in guided missiles can be summarised as follows:

1. Change in input voltage requirements from 12.5 to 28 volts DC.
2. Necessity for simultaneous operation of several television channels.
3. Desirability to separate the camera and transmitter into two units.

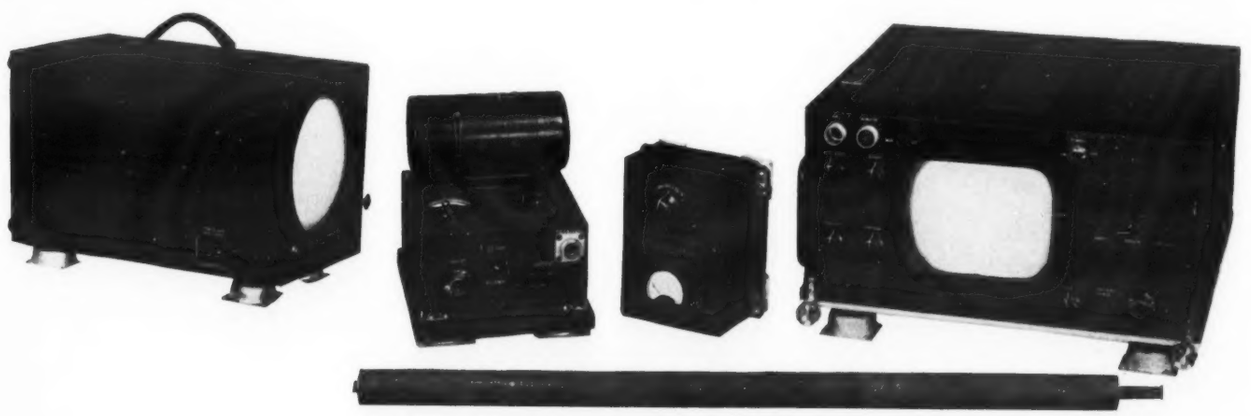

Fig. 2
Receiving equipment SCR-550-T2. l. to r.: Receiver Monitor, Monitor power supply, receiver voltage control box, receiver and 100 MC "Bazooka" just below.

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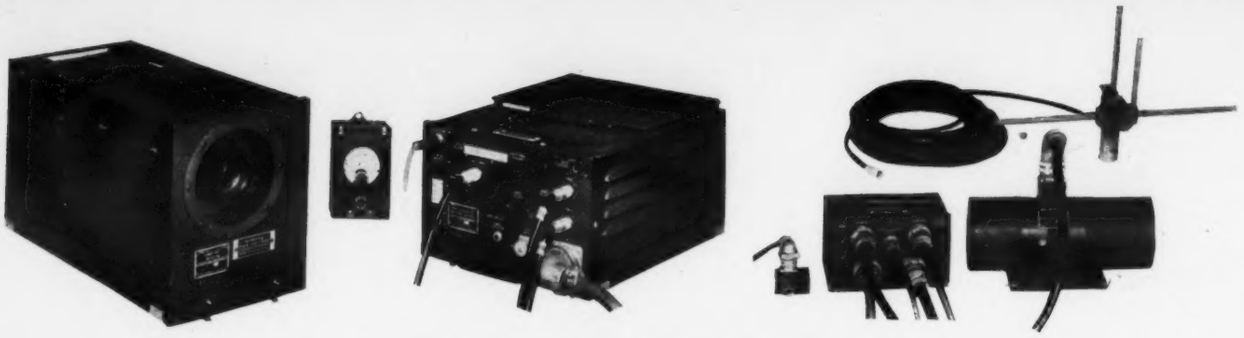


Fig. 3: Radio transmitting equipment SCR-549-T3.

4. Necessity for the use of smaller antennæ.
5. Necessity for the equipment to operate at low temperatures and high altitudes.

If success is to be achieved in the design of equipment for expendable missiles, the philosophy of low cost has to be disregarded entirely. While missiles have no recoverable material, they must be extremely reliable. Since the cost of the television transmitting equipment (approximately $2,000), represents only a small portion of the cost of the entire missile, especially in the case of " war weary " aircraft, savings are not justified if they result in unsuccessful missions. Therefore, it was emphasised that, although the equipment was expendable, design and production had to be in accordance with standard Signal Corps requirements, which closely represented actual conditions that would be encountered in military use of airborne radio equipment.

The new *300-megacycle equipment*, which was to incorporate all the afore-mentioned features and would avoid the limitations of the 100-megacycle equipment, became known as SCR-549-T3 and SCR-550-T3. In addition, a number of improvements were included which had been found to be of importance during field tests with the 100-megacycle equipment. For instance, experiments had shown that plate modulation of the synchronising signals was superior to grid modulation as it prevented " clipping " of synchronisation under conditions of high contrast which caused a shift in the operating point of the grid.

The operation of the 300-megacycle television sets is essentially similar to that of the 100-megacycle equipment, but differs as to details. In the case of the transmitting equipment (Fig. 3), it can be seen that the camera-transmitter unit has been separated into two units and because of this its weight was increased to 90 lbs. Video and synchronisation have been separated and modulate the grid and plate, respectively, of the power amplifier. In the camera, synchronising amplifiers and mixers have been added to standardise these signals for operation of either transmitter or the monitor. Because of the lower efficiency of 300-megacycle operation the input power was raised to 29 amperes at 26 volts.

Experience with the camera of early units indicated that more care would be required in the design of the video amplifier with regard to low-frequency microphonics. A

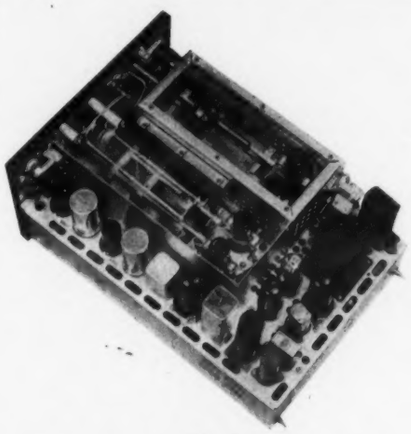
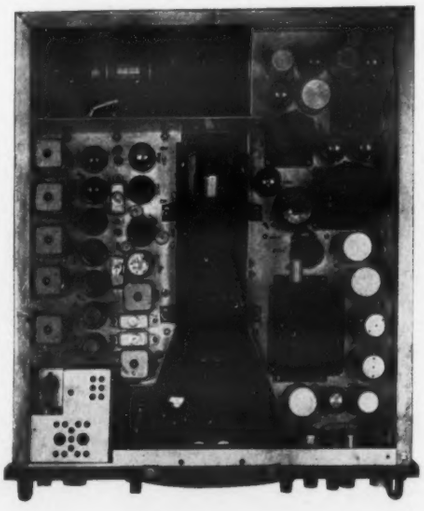


Fig. 4
Radio transmitter BC-1212-T3: master oscillator on right side, power amplifier in centre, video amplifier and modulator on left side, and synchronising amplifier and modulator at bottom.

leveller or " clamping " circuit was devised such that low frequencies, eliminated by the use of small coupling capacitors in the video amplifiers, are in effect reinserted by the last video stage prior to the addition of the black level and blanking.



In the camera section of the 100-megacycle equipment a particularly troublesome effect was the formation of a horizontal bright bar across the top edge of the received picture. It was finally determined that the cause was an undesired pulse produced by the vertical blanking pulse in cutting off the iconoscope beam. This was corrected by introducing a vertical pulse of opposite polarity, which neutralised the unwanted effect. This compensating " flare blanking " pulse restored proper vertical blanking but produced a slightly wider interval than was desired.

The new transmitter was designed to cover a range extending from 260 to 320 megacycles. This wide-frequency range with one set of tuning elements necessitated the use of variable tuned lines (Fig. 4).

The last versions of the 100-megacycle receiver operated so successfully that only a few significant electrical changes were necessary to achieve the 300-megacycle design (Fig. 5). The converter section, of course, was of completely new design. As in the case of the transmitter, it was found necessary to use tuned lines as the tuning elements of the RF circuits in the receiver.

The monitor unit (Fig. 6) is of the direct driven (slave sweep) type. It can be used either for observing the output of the camera

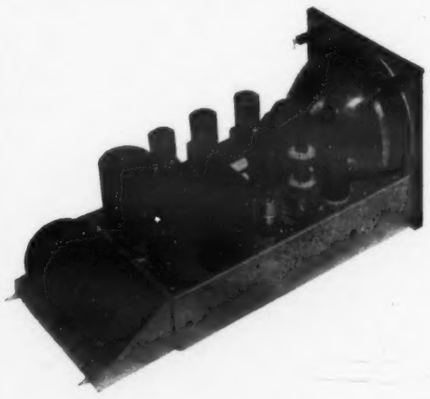


Fig. 6
Monitor unit BC-1214-T3.

← *Fig. 5*
Radio receiver BC-1213-T3: top view showing converter, IF amplifier, and video amplifier on left side; deflection and high voltage circuits are on the right side.

or for providing an additional picture at the receiving location when it is driven from the output of the receiver.

After a number of flight tests had been performed with this equipment, it was found that combination of FM and multi-path transmission of signals caused a great amount of interference in the receiver. Because no buffer stage was used between the master oscillator and the power amplifier, the latter reacted on the oscillator and produced a frequency deviation of as much as 200 Kc in early models.

The combination of multi-path transmission and FM results in the simultaneous reception of two different frequencies in the receiver. This effect has been utilised to advantage in the FM radio altimeter, but is undesirable in the transmission of television pictures. The resulting best note due to the difference in the frequencies of the direct and reflected signals will be within the video band accepted by the receiver. A reduction in FM was effected by changing the tuning procedure of the transmitter and reducing the load on the master oscillator. As a result, the power output was somewhat reduced, but this did not materially affect the tactical range of the equipment.

Difficulties were also experienced with the electrical noise caused by the ignition system of the airplane engines. The receiver is very sensitive and ignition interference will manifest itself in the form of small white dots closely resembling a snowstorm in the picture. Improvements in the design of aircraft ignition systems corrected this fault.

The 100-megacycle equipment was delivered early in 1942, and *flight test work* began immediately at Wright Field. The transmitting equipment was installed in a small General Motors PQ-8 target airplane while the receiving equipment was installed in a Douglas B-23 twin-engined bomber (see Fig. 7). These flight tests demonstrated that airborne television was practical, but certain difficulties were found to exist which made it necessary to redesign the equipment.

Upon close examination of Fig. 8, it will be apparent that the television camera must look through the propeller disc. The light reducing effect caused by this fact comes in the form of pulses, one pulse per blade. For typical small engines, the frequency generated is approximately 80 pulses per second or two bars per frame and can cause serious disturbances in the camera operation.

Since there were no plans for the use of small single-engined aircraft as guided missiles, little effort was concentrated in finding an exact solution to this problem. A fair answer was found by reducing the low-frequency response of the camera video

Fig. 7 : Remote control pilot's installation in Douglas B-23.

Fig. 8 : General Motors " Bug " showing 100-MC television antenna on top of fuselage and ventral nacelle containing camera-transmitter.

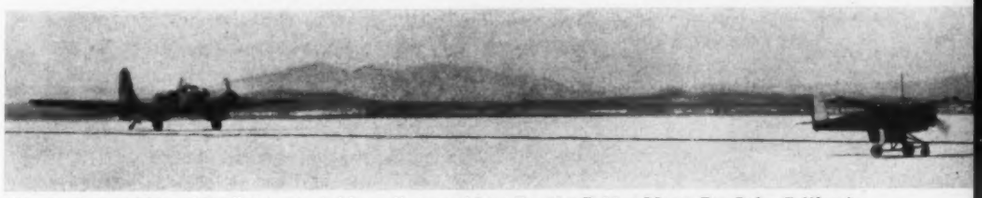


Fig. 9 : General Motors "Bug" being taxied by radio control from Douglas B-23 at Muroc Dry Lake, California.

Fig. 10
XPQ-12A target airplane showing nacelle for camera-transmitter under right wing. In bomb position a 500-lb. bomb is placed in pilot's cockpit.

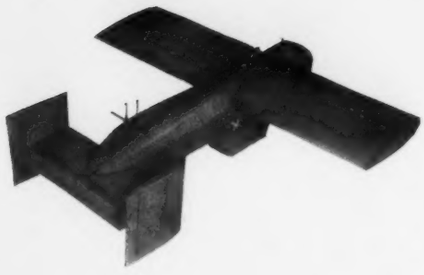


Fig. 12
Top view of GB-4 glide bomb. Television antenna is just ahead of horizontal stabiliser.

amplifier such that the attenuation of the low frequencies extended to about 8,000 c/s.

During the month of May, 1943, tests were made at Muroc Dry Lake, California, using the General Motors " Bug " as guided missile (Fig. 8). In this particular installation the 100-megacycle television camera-transmitter unit was housed in a ventral streamlined nacelle, while the antenna was mounted dorsally. The radio and flight servo equipment were located inside the fuselage. After a number of tests had been made with this combination, the " Bug " was finally caused to dive into a target by radio control, using television as means of guidance (Fig. 9).

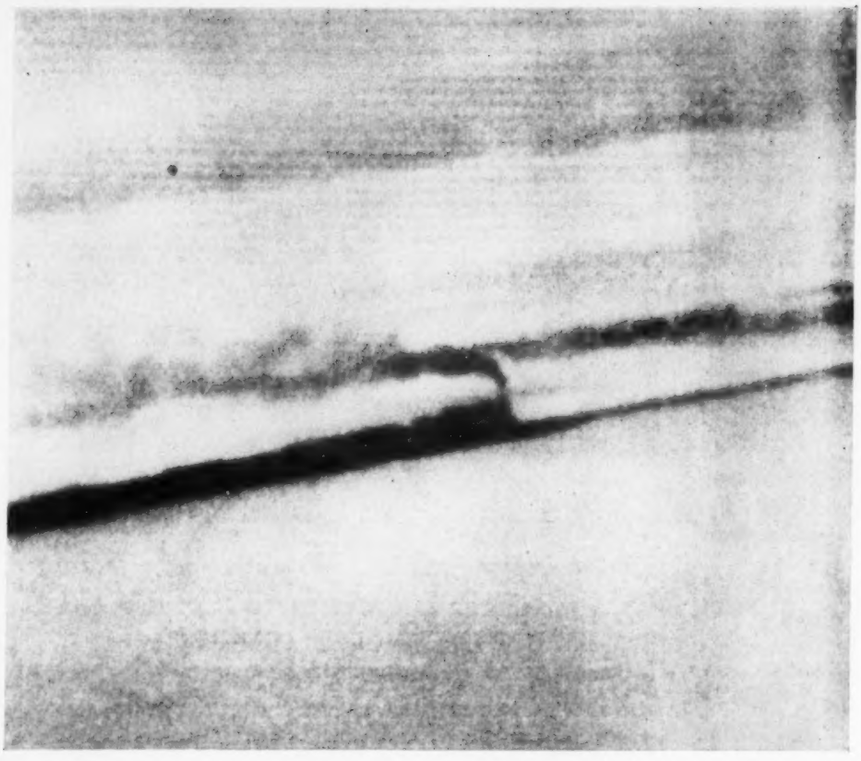


Fig. 11 : Moving train as seen on television screen at Muroc Dry Lake, California. Camera was located in XPQ-12A airplane making simulated attack.

Fig. 13
Target area at Eglin Field, Florida, as seen on the television receiver screen. Pyramidal target is in the centre of the circular area.

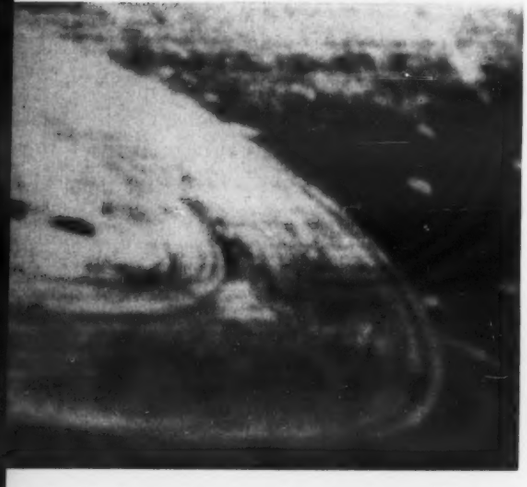


Fig. 14
Television picture received from GB-4 glide bomb turning into pyramidal target at Eglin Field, Florida.

During August, 1943, it became apparent that all of the units of the power-driven bomb (aircraft, power plant, flight servo, radio control, and television equipment) had been sufficiently developed to warrant a demonstration before interested military officials, so that a mission left for Muroc Dry Lake to test the military possibilities of these missiles. In this case, SCR-549-T2 transmitting equipment was installed in YPG-12A aircraft, to be used as power-driven bombs. The YPQ-12-A (Fig. 10) is a single-engined type, but it was possible to mount the television camera so that its line of vision would be outside the propeller arc.

For the final or bomb run, a 500-lb. bomb was placed in the safety pilot's cockpit. During tests, the television picture proved adequate, so that complete control over the missile could be maintained at all times (Fig. 11). For its final run, the missile was controlled directly behind a second radio-controlled airplane and then exploded by means of signals over the radio control equipment.

During June, 1943, a small number of GB-4 Glide Bombs became available and enabled the performance of the 300-megacycle equipment to be tested. The GB-4 glide bomb (Fig. 12) consisted of a standard 2,000-lb. bomb to which an airframe had been fitted. The flight servo equipment, radio control equipment and television transmitting equipment were housed in the body of the airframe, while the camera was located in a streamlined nacelle beneath the bomb.

Once the first flight tests had indicated that the installation and operation of the equipment was satisfactory, it was decided to drop a number of GB-4 glide bombs to determine the practicability of hitting a small target with this missible. Very unsatisfactory television pictures were received from the first 5 glide bombs dropped during August, 1943, at Eglin Field, Florida. Analysis of the motion pictures taken of the television receiver screen revealed the following interference effects :

1. Fine horizontal lines in the picture, produced by acoustic pick-up in the camera (3,000-4,000 c/s). This high noise was generated apparently by wind rushing past the GB-4 glide bomb and a solution was found by placing the camera in a sound-proofed box.

2. Heavy horizontal bars in the picture, produced by acoustic pick-up in the transmitter (120-200 c/s), apparently generated by the plywood body of the airframe. A solution was found by sound-proofing the inside of the airframe.

3. Heavy streaking through the picture, caused by loose bonding. After all metal parts in the airframe had been well bonded, no further trouble was experienced.

4. Change in picture shading caused by the influence of the earth's magnetic field on the iconoscope. The difficulty was overcome by installing a magnetic shield around the entire iconoscope.

5. " Blooming " of the top half of the picture and loss of video information caused by iconoscope saturation. It was found that a yellow filter in front of the camera lens was the most effective solution, especially under conditions of high light levels and low contrast caused by haze.

6. Loss of synchronisation and streaking caused by RF feed-back in the cables going from the camera to the transmitter. Installation of a few by-pass condensers solved the trouble.

7. Interference from the radio control system. The system then in use operated between 80-90 Mc/s, the third harmonic of which would sometimes interfere with television reception. The difficulty was overcome by proper selection of RF channels.

8. CW interference, caused by other transmitting equipment in the control airplane manifested itself in a fine herring-bone pattern similar to that produced by diathermy machines, and obscured the picture. A solution was found by improved bonding of the receiver antenna cable.

Investigation of microphonics showed that certain iconoscopes had stronger microphonic tendencies than others, so that standards were set up with the aid of an acoustic box in which iconoscopes were subjected to noise levels similar to those encountered in actual practice. Iconoscopes could be used if they passed this noise test. Trouble was also experienced for the first time with lens fogging and, consequently, optical heaters were installed in all cameras.

By this time, the tactics of guided missiles became more important and it was realised that in order to make full use of the equipment, the range, which was 12 to 20 miles at that time, would have to be increased. A directional antenna in the receiving airplane coupled to a gyro-stabilised antenna mount, resulted in a range of 50 to 80 miles.

After all these difficulties had been eliminated, satisfactory television pictures were received from the GB-4 and the television equipment was considered ready for tactical operations (Figs. 13 and 14).

A glide bomb operating group was ordered to England during June, 1944, and a " Castor " group was sent shortly afterwards.

" Castor " was the code word for the use of " war weary " heavy bombers as guided missiles. The aircraft were to be loaded with explosives and guided into targets by means of radio control and television. The television camera was located in the nose of the aircraft, while the transmitter, power supply and antenna were mounted in the tail. The equipment used was identical to that used in the glide bombs, except that power was derived from the airplane electrical system and a selsyn compass indicator was added to the camera. This compass projected a course which could be read directly on a small part of the iconoscope mosaic in the upper right-hand corner.

Although difficulties were experienced in the beginning with reflections of a new variety due to the increased altitude of operation, this trouble was overcome and good pictures, free from all interference effects, were observed during the later raids with GB-4 glide bombs and " war-weary " missiles (Fig. 15).

In conclusion it may be said that airplane to airplane transmission of television pictures is feasible. Many difficulties may still be encountered but, in general, successful transmission may be accomplished if the following precautions are observed :

1. Transmitting equipment must be protected from interference produced by acoustical noises encountered in aircraft.

2. A stable master oscillator has to be used in the transmitter, preferably followed by a buffer stage, in order to keep the frequency deviation due to frequency modulation less than the picture line frequency.

3. The ratio between the direct and reflected signal strength in the receiving airplane must be kept as high as possible.

4. The contrast of the viewed scene must be high and possible targets should be chosen for their proximity to prominent landmarks so that they can be located easily.

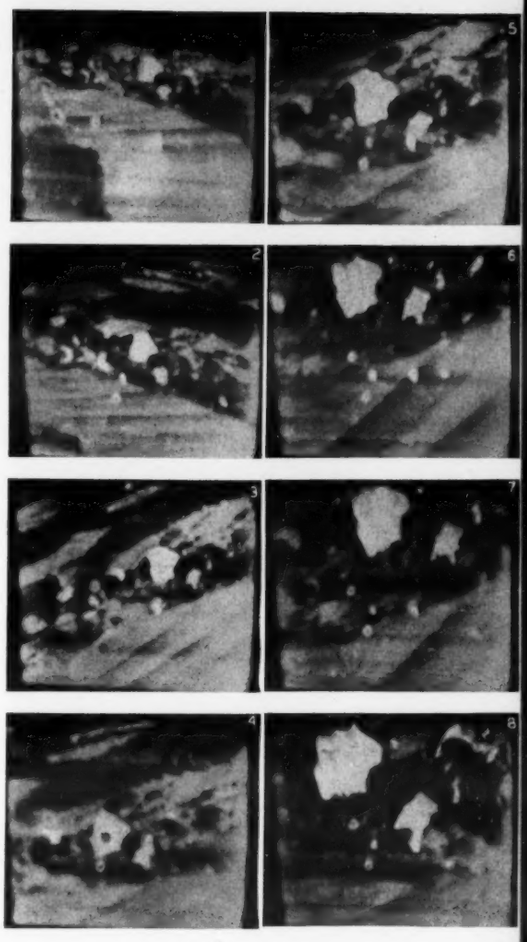
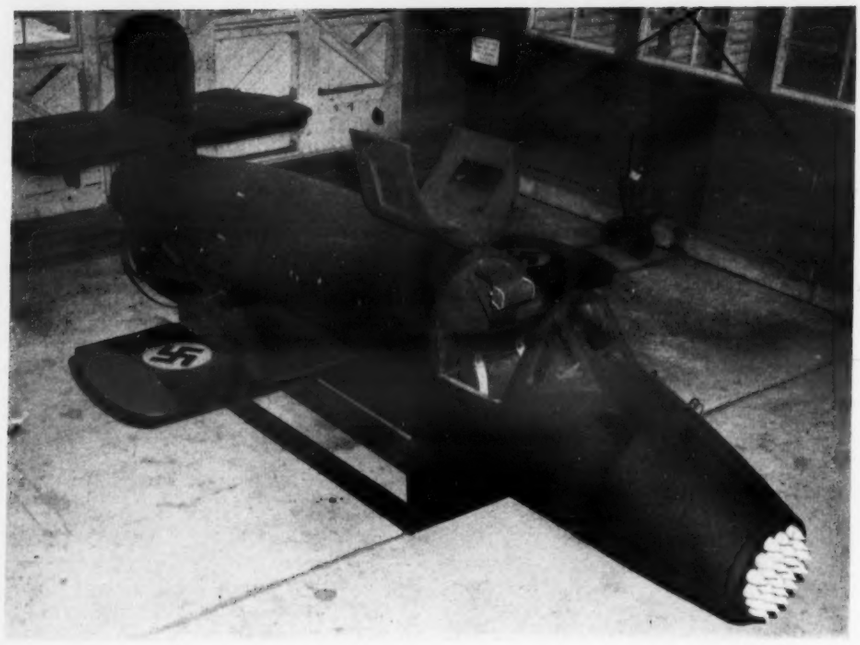


Fig. 15
A series of frames taken from motion picture film showing glide bomb approaching target in Germany.

THE " NATTER "

During the last phases of the war in the air against Germany, when the superiority of the Allied air forces declared itself invincible and impervious to either fighter aircraft or anti-aircraft cannon attack, the leaders of the Luftwaffe feverishly sought a new defence method which would combine the advantages of the manned fighter with those of A.-A. artillery.

In addition to turbo-jet engines, which considerably improved the performance of German fighters, rocket motors of the Walter type were also available as seemingly suitable power plant for such developments. The first German fighter to be equipped with one of these bi-fuel rocket units was the Messerschmitt Me 163. However, operation revealed its excellent speed and rate of climb to be countered by a whole series of disadvantages. Although the fuel used in the Me 163 (C-Stoff : solution of hydrazine hydrate in methanol ; T-Stoff : concentrated hydrogen peroxide) was sufficient for six minutes of full thrust, the flight duration was found to be inadequate for a fighter ; and with the fuel consumed, the aircraft, obliged to glide, was an easy target. Moreover, the Me 163 needed a



certain distance in which to take off and land, so that its operation was confined to large airfields which, rather easily detectable, could be kept under watch. However, one of the main draw-backs was the amount of skill and physical resistance it demanded of a pilot.

Hence, the German aeronautical industry was set the problem of developing a machine which, retaining the high rate of climb and speed of the Me 163, would obviate the latter's shortcomings by a tendency towards artillery methods, and the manufacture of which would require a minimum of man-hours. In order to be able to do without an undercarriage and keep the take-off facilities small, the machine had to be launched from a stationary ramp in the nearest possible to vertical direction, thus simultaneously achieving the most favourable climbing performance. With complete independence of equipped and easily-noticed airfields, it was foreseen that the pilot should bail out once he had fulfilled his mission. At the same time, a great simplification in training was expected, as the pilot had only to master flight control, target approach and warload release, and could disregard take-off and landing technique. It is questionable whether this expectation would have been warranted, for successful firing on a moving target whilst flying at 500 m.p.h. is hardly to be expected of a beginner pilot.

It was planned that the new rocket aircraft should be controlled in accordance with a predetermined programme, a method similar to that usually employed in anti-aircraft gunnery, i.e., taking the direction of a given point which is determined from data concerning the target's position, direction and speed of flight, supplied by the radio observation service. Once the target discovered, the pilot should obtain a final aim correction by curving in to the rear of the enemy aircraft and then fire the guns, housed in the nose, from a distance of not more than 400 yards. The whole apparatus was planned from the start as expendable, the work-hour and constructional material expenditure of which was not to exceed 10 percent of that of a conventional fighter aircraft, and the airframe and power plant of which should not necessitate more than 500 hours to complete.

Towards the end of summer, 1944, these directives, according to which the Germans expected a simplified aeroplane incorporating maximum effect with a 90 percent assurance of attaining the target, led to the design of a manned rocket and its experimental prototype construction under the name of " Natter " (adder or viper) by the Bachem aircraft works at Waldsee, Württemberg.

This project was not spared the difficulty inherent in all rocket aircraft, because of the extraordinarily high fuel consumption, namely, how to combine minimum gross weight with the necessary thrust and adequate flight duration. On the one hand, an aircraft of the size of the Me 163 should be avoided ; on the other hand, the Walter rocket engine consumed 20.9 lb./sec. of fuel at a full thrust of 3,860 lbs. — For reasons of simplification and economy, the " Natter " was built entirely of wood, and various models were subjected to tests in tow, gliding trials and propelled take-offs at the Heuberg gliding centre.

The most recent experimental version featured a three-section monocoque fuselage, of which the nose, containing the gun and front part of the cockpit canopy, was jettisoned prior to the ultimate parachute jump. In order to reduce the speed before bailing out, a brake parachute at the rear could be released. The fuselage centre section, firmly glued to a wing of 11.8 ft. in span, contained the pilot's seat and fuel tanks ; the fuselage rear housed the rocket engine. The elevator unit, embodying a combined elevator and aileron action, was set high and firmly glued to the vertical stabiliser.

Already tried out in the Me 163, the Walter 8-109.509 A 2 rocket engine with thrust adustable between 330 lbs. and 3,860 lbs., was chosen as power plant. The capacity of the fuel tanks sufficed for 88 Imp. gals. of T-Stoff (weight, 1,200 lbs.) and 42 Imp. gals. of C-Stoff (385 lbs.). In order to allow for control of the " Natter " already at take-off, i.e., before the aerodynamic control surfaces became effective, a steel rudder was built into the jet stream.

The aircraft equipment was cut down to a minimum and, besides an altitude respirator and a parachute, comprised the most necessary instruments only, such as altimeter and air speed indicator. At the summer, 1945, development stage, remote control systems were not available and the K 23 fighter course control incorporated in the Me 163 and other aircraft was too complicated for this purpose, besides being too costly for an expendable apparatus. Hence, development was planned of a simple automatic pilot out of a gyro-compass, an inclinometer and an accelerometer, in order to assure exact maintenance of course, angle of climb and radius of the redress curve. Armament was confined to a firing ramp in the nose, with 24 barrels for 2.874-in. calibre explosive recoil-grenades. These were to be released in one operation which entailed automatic firing of the group. The aiming device was to have consisted of a conventional mirror reflex sight.

In order to keep the length of the ramp as short as possible, four take-off rockets, each of ten seconds duration, were fused, their output adding to the full power of the engine. These take-off rockets were located around the fuselage rear as jettisonable units with their axes pointing towards the centre of gravity of the aircraft at an angle of 23° to the longitudinal axis.

Numerous trials took place with this equipment during the latter months of the war, whereby the framework ramp, visible in the photograph, was finally replaced with a simple wooden mast construction with rotatable guide rails of 28 ft. in length. Altitudes up to 10,000 ft. were attained in unmanned firing trials without engine, i.e., with take-off rockets only. Only one manned

take-off was undertaken with engine, this shortly before the capitulation of Germany. However, the result was fatal as the pilot —presumably affected by the acceleration— involuntarily executed a downward dive.

Parallel with the technical development of the equipment, physiological investigations were conducted concerning the influence of the take-off acceleration and high rate of climb on the human body. Whilst the take-off acceleration of about 3.1 G.Abs. during 10 seconds and the average rate of climb of 410 ft./sec. were considered as supportable, the centrifugal force during the redress curve reached an extraordinarily high value. In consequence, it was planned that later developments should provide for pilot accommodation in prone position.

The tactical control likewise formed the object of extensive research. It was found to be of advantage to release the "Natter" vertically and that the pilot should carry out his attack flying in a straight line at 30° to the path of flight of the target. At the same time, the path of flight of the target should be attained at about 3,000-6,000 ft. to the rear. Hence, the pilot would have to fly along a pre-determined, automatically-controlled, straight path of flight until the target came into his field of vision. After curving in and reaching the prescribed firing distance, he was to release his war-load. It was decided that approaching from the rear at an angle of 0-10° was the most advantageous plan of attack, again in order that a minimum of flying skill and shooting training should be required.

Control of the manned rockets was to have been carried out from a ground station which would have had command over several firing ramps, simultaneously transmitting to these information on enemy positions obtained from the radar observation service.

The last version to be developed of the "Natter", actually that involved in the accidental take-off, featured the following characteristics :

Length	20 ft.
Span	11.8 ft.
Wing chord (rectangular wing)	3.28 ft.
Wing area	38.7 sq. ft.
Horizontal tailplane span	7.55 ft.
Horizontal tailplane area	24.7 sq. ft.
Vertical tailplane area	18.3 sq. ft.
Distance from nose to leading edge	8.2 ft.
Centre of gravity location :	between 50 and 60 percent of wing chord

WEIGHTS

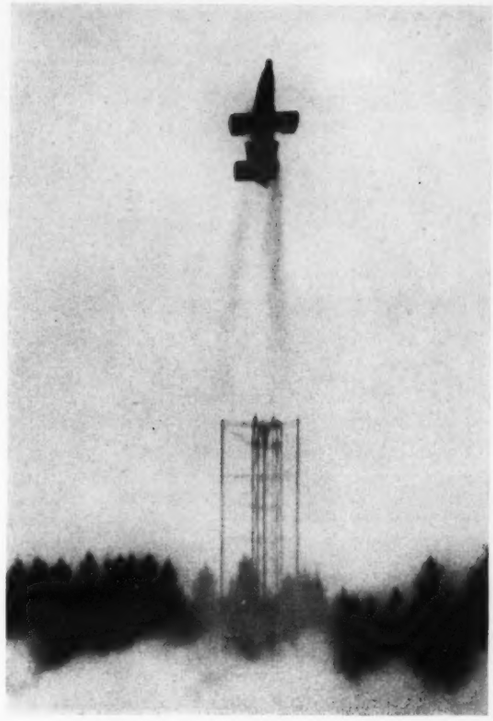
Gross weight without fuel and without take-off rockets	1,985 lbs.
Fuel : 88 Imp. gals. T-Stoff	1,200 lbs.
42 Imp. gals. C-Stoff	385 lbs.
Four SG 34 take-off rockets	1,060 lbs.
Wing loading at take-off	119.5 lb./sq.ft.
Wing loading during flight	51.2 lb./sq.ft.

DESIGN PERFORMANCE

Max. horizontal speed	497 m.p.h.
Time to climb to 32,800 ft.	80 sec.
Vertical climbing speed	280 m.p.h.
Full thrust duration	80 sec.
Take-off acceleration	31 G.Abs.

The "Natter" represents only one of the many means of defence developed by the German aircraft industry during the latter months of the war. The reason for describing it fully is because the "Natter" represents a characteristic intermediate stage between the fighter aircraft defence methods used at the end of the war and the artillery defence methods now being developed. In view of the volume superiority of the Allied air forces, the German military leaders realised that their industry was too small to cope with the manufacture of fighters in sufficient number. As, on the other hand, the automatic control equipment for anti-aircraft missiles was not sufficiently accurate at that time, a stop-gap stage was created which allowed for a last aim correction and the final shooting to be carried out by a pilot, this after a ground station had guided the aircraft to within eye range of the target.

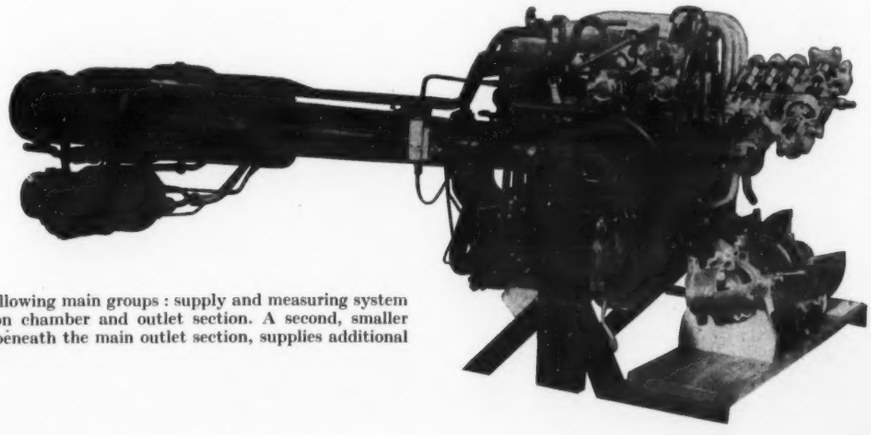
Again, even if the "Natter" had been put into service before the end of the war, it is not likely that it would have lasted very



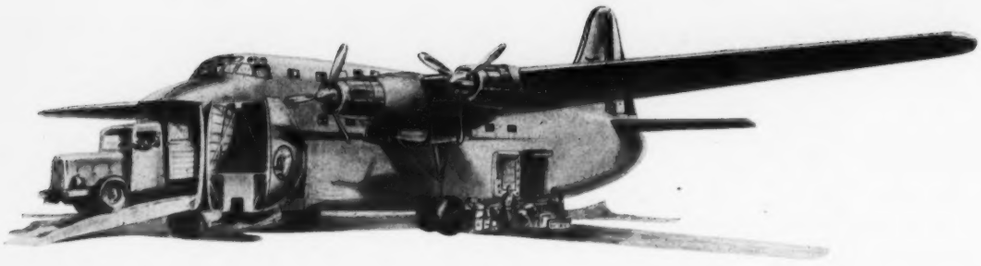
long. A full thrust duration limited to 80 seconds all the same precludes combat operation at more than 26,000 ft. altitude. American flying equipment which was in preparation at the beginning of 1945 was designed for operational altitudes of at least 32,000 ft. The question remains open as to whether the "Natter" could not have been improved so as to cope with corresponding altitudes. In any case, it would have been necessary to equip the cockpit with pressurisation apparatus, etc., thus making it heavier.

It is scarcely to be expected that the future will bring further such semi-automatic, expendable devices ; and a clue as to what is effectively to be expected may be drawn from the article elsewhere in this magazine concerning experiments in America with television equipment for guided missiles.

Bi.



The *Walter bi-fuel rocket engine* comprises the following main groups : supply and measuring system for the two fuels, injection nozzles, combustion chamber and outlet section. A second, smaller auxiliary combustion unit, situated at the left beneath the main outlet section, supplies additional thrust over a short period.



AEROCENTRE "CORMORAN"

By Chief Engineer Robin, S.N.C.A. du Centre.

The first preliminary studies which the Société Nationale de Constructions Aéronautiques du Centre (S.N.C.A.C.) undertook for the development of a pure cargo transport aircraft go back to the war period when the concern's technical departments were grouped together with those of other State-controlled aircraft firms.

At the beginning of 1945, when S.N.C.A.C. were able to resume charge of their own departments, the cargo aircraft specialists continued their studies in the new organisation. During the course of the same year, they received a contract to supply the Technical Service of the French Air Ministry with draft designs for a series of cargo aircraft including one to be known as the NC 210, of 56 tons gross weight and driven by four Gnome & Rhône 18R 18-cylinder twin-row radials of 2,070 H.P. each for take-off. But as the construction of this engine was suspended early afterwards, the firm had to start on a new design at the end of 1945 which, derived from the first one, was to be for a cargo aircraft of about 40 tons gross weight and equipped with Gnome & Rhône 14R 14-cylinder engines of 1,580 H.P. This design was to be the NC 211 " Cormoran ".

In the meantime, the French General Air Staff also recognised the eventual utility of an aircraft of this kind as a military transport medium, especially for the carriage of heavy trucks. The result was that the original project was once more revised and a larger cargo hold provided in the design.

Finally, in March of 1946, the design was approved once and for all and construction began in an energetic way. Work was begun immediately on a prototype at the S.N.C.A.C. works near Paris and thanks to considerable efforts the fuselage and tail assembly were completed in good time for the French Aeronautical Salon which opened on November 15th. The finished aircraft is scheduled to undertake its first trial flight towards the middle of this year.

Description

The NC 211 " Cormoran " is a four-engined high-wing monoplane of all-metal construction with retractable nose-wheel. The dimensions of the cargo hold, which were determined in advance by the purchaser and are exceptionally large for an aircraft of this engine power, aimed from the start at a highest possible payload. The permissible weight of an aircraft is contingent upon its ability to fulfil certain conditions as regards rate of climb and angle of ascent at take-off ; as is known, international regulations also demand definite minimum performance figures with one engine cut out. Hence, it was a case of achieving the best possible results with the available power from the four engines, most of all at take-off ; in consequence, the three-blade airscrews possess proportionately large diameters. The " Cormoran " will reveal the greatest economy in operation over routes of about 600 miles distance. Its disposable load, including fuel and oil, amounts to about 17 tons, and its normal fuel tanks permit about 1,250 miles to be flown against a 30-m.p.h. headwind without intermediate stopping.

The main parts of the prototype are made from a light alloy capable of resisting 25.8 tons/sq.in. Provision is made for the incorporation of a constructional material to support 35 tons/sq.in. in later versions, in order to allow for the installation of bigger power plant and an increase in payload without raising the weight of the airframe.

All rivet locations are situated in such a manner as to provide for easy access with a rivetting machine ; and for this purpose, box-type constructions were avoided throughout as regards the frames, ribs, bearers, etc. In order to lower the constructional costs still further, cambered finish to junction points was avoided as often as possible. Flush rivetting is featured only on the forward part of the wing and tailplane. The fittings consists of special steel plates of 76 tons/sq.in. resistance for unwelded sections and 63 tons/sq.in. wherever welded.

Fuselage

The form and dimensions of the fuselage were determined by the main cargo hold, the cross-section of which is approximately rectangular and remains the same over the major part of its overall length of 59 ft. The inside of the cargo hold is free from any disturbing constructional parts as the structure supporting the wing passes over it. Thanks to the wide angle of wing incidence the floor of the fuselage comes to lie almost horizontal whether the aircraft is in flight or on the ground.

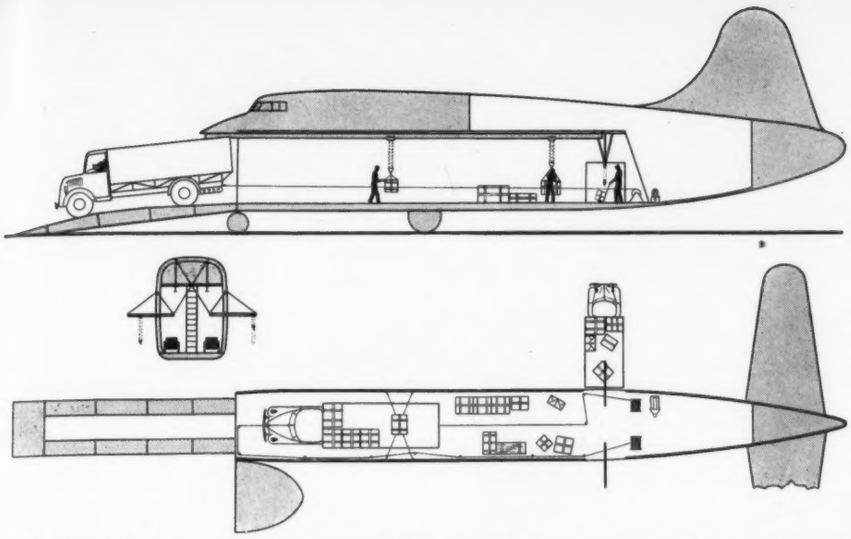
For loading and unloading of bulky commodities, the nose section can be opened out towards the left ; further access is available at the rear of the cargo hold through a loading hatch on either side and, finally, a small door is situated on the forward port side, from which a ladder leads to the upper deck.

In order to expedite loading operations, there are two electric winches at the rear end of the cargo hold and two ramps which go with the aircraft and facilitate the passage of trucks, etc., through the nose door. In addition, the handling of cargo inside the hold is facilitated by two 1,100-lb. pulleys running on rails the length of the roof and two additional cranes of equal strength which may be driven along rails to extend through the side loading hatches. Both the winches and cranes are driven by a three-phase current of 115-200 volts supplied by a generator group housed in the rear part of the fuselage, or which can also be drawn from a ground installation.

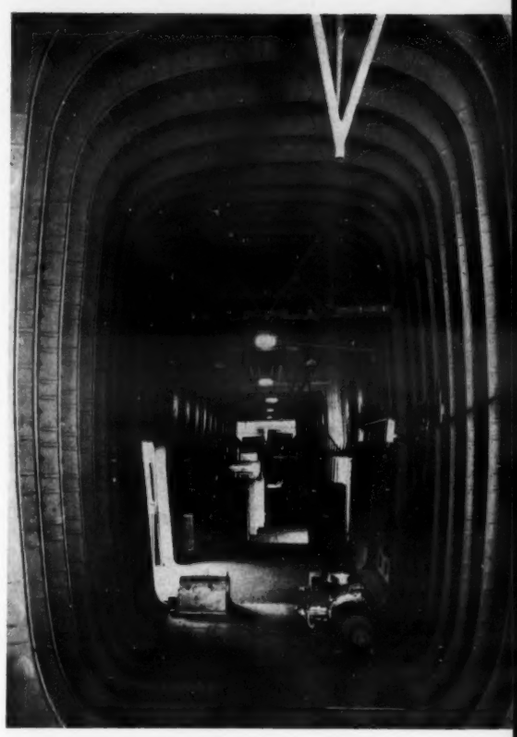
The walls and floor of the cargo hold are fitted with rings for tying down loads with chains and cables.

The already mentioned ladder leads through a hatch into a small compartment on the port side of the upper deck ; from there a door leads into a corridor passing from the flight deck to the passenger cabin further aft. A lavatory is likewise located on the port side of the fuselage. The planes of the airscrew discs cut neither the flight deck nor the passenger cabin, but pass between them through the zone formed by the above-mentioned compartments.

The pilot's cabin, fitted with large windows in front and at the sides, provides plenty of room for four crew members : pilot and co-pilot, radio operator-navigator and engineer ; normally, however, it is only necessary to carry a three-man crew. The two pilot seats are arranged asymetrically to the centre line of the fuselage : the captain sits on the port side against the side of the fuselage and has a clear view straight downwards through a flap-window, whereas the co-pilot's seat is starboard but nearer to the centre line. The control unit, containing the instruments for servicing and supervising the engines, the automatic pilot and airborne plant, is situated between the two pilots' seats and in front of the engineer who, sitting more to the rear, also has a clear view of the instrument panel. Behind and to the right of the co-pilot is the radio operator-navigator, who has a swivel chair enabling him to work either at a table facing forwards, or to turn to his radio equipment which is fixed against the side of the fuselage at his right. The roof of the flight deck is provided with an emergency exit.



Loading the "Cormoran". The electric winches at the rear end of the cargo-hold drag a heavily loaded lorry up the ramp through the large nose opening into the fuselage. Freight is lifted up through the side loading hatches by means of the 1,100-lb. cranes suspended on folding cross rails. The handling of cargo inside the hold is facilitated by two further cranes of the same strength, running on rails along the roof.



Rear view into the main cargo hold. In front on the floor are the winches for drawing loads up through the nose opening. Against the roof are the two cranes running its entire length, in between which is the cat-walk coming from the passenger compartment; the ladder leading from the rear part of the fuselage to the cat-walk has been taken away.

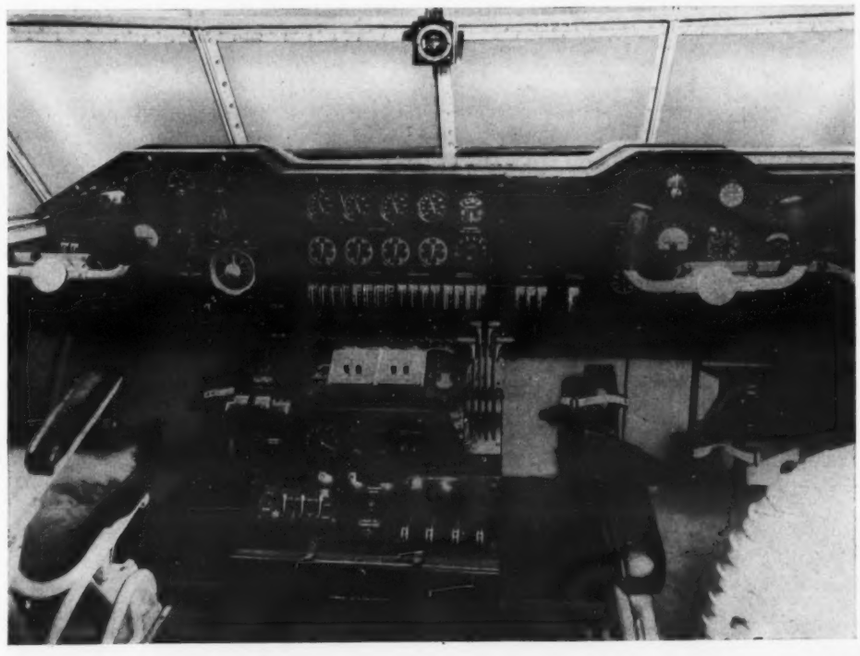
The passenger cabin contains seven seats and may be entered directly from outside through a side door on the port side. Its rear limit, which also contains a door, is formed by the main bulkhead on to which grip, on either side of the main spars, the wing panels. Aft of this bulkhead is a small freight or luggage compartment with a roof-hatch and a back door leading to the rear end of the main cargo hold over a cat-walk under the latter's roof. The entire fuselage is composed of five main assemblies: upwards-folding nose section, centre section with main cargo hold, super-imposed upper deck, rear fuselage section and tail covering. Of conventional semi-monocoque construction, it consists of bulkhead frames with rivetted skin of varying thickness and mostly single curvature, re-inforced prior to assembly with longitudinal stringers. In the vicinity of the cargo hold, the bulkhead frames are all of the same size and spaced at regular intervals in order to allow for interchangeability of most of the floor panels (hard-wood frames with plywood covering on both sides and balsa wood in between). Longitudinal and lateral beams underneath these panels give the whole floor considerable supporting strength.

The passenger cabin aft of the flight deck.

Wing

Each wing panel of the "Cormoran" is trapezoidal and round-tipped; each is again divided into outboard section with detachable end piece and an inboard section attached to the fuselage and bearing the engine nacelles. The wing sections are fastened together, and with the fuselage, by means of universal joints and strips of adjustable length in order to facilitate assembly should there be any small inaccuracy in the dimensions of the main assemblies. The four main sections have a main spar with a full-wall web and flanges connected to it by means of L-extrusions; this main spar supports the major bending strain. Torque is absorbed by a torque-resisting box consisting of two auxiliary spars and the parts lying between them of the upper and lower skins. The auxiliary spars likewise have full-wall webs to which are rivetted L-extruded flanges. The transversal ribbing of the wing is formed of ribs of the same structure as the auxiliary spars. In order to re-inforce the covering, the panels of which it is composed are equipped with stringers running at an angle to the spars, prior to assembly of the wing section. The detachable leading edge sections, fastened on by means of screws and containing hot-air channels for de-icing, complete the airfoil fore of the forward auxiliary spars.

Twelve fuel tanks are housed between the main and auxiliary spars of the inboard wing section; the leading edge portion of the inboard section contains four oil tanks.



Flight deck as seen from engineer's seat. The pilot's seat is on the left and the co-pilot's on the right. Behind this and further to the right is the navigator's seat and radio equipment.

Each wing panel is equipped with three split-type landing flaps, the hinges located inside the wing; when extended they are considerably displaced towards the rear.

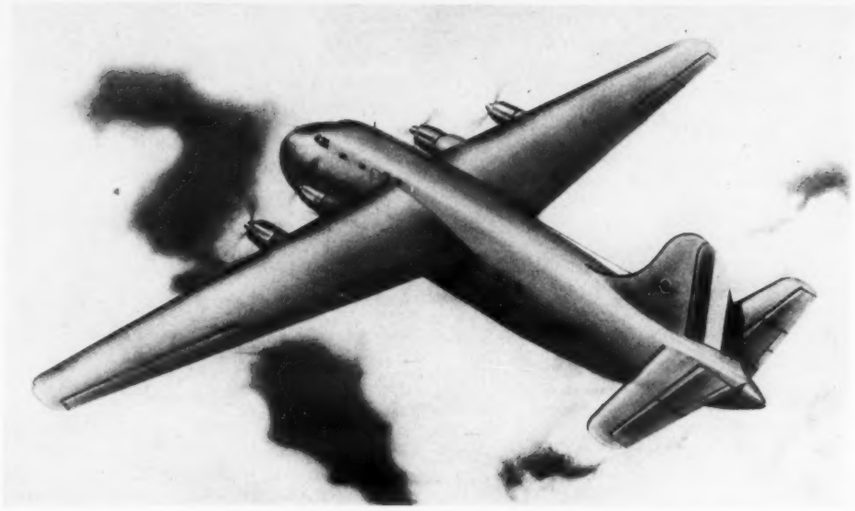
The aileron on each outer section is divided into two flaps, the inner one fitted with a trimming tab adjustable on the ground. For aerodynamic balance the hinges of the ailerons are set to the rear, whereas static balance is obtained by means of masses distributed over the leading edges.

Tail unit

The horizontal stabiliser has a pair of continuous spars which are connected to the rear bulkhead and, inside the fuselage, supported by two tubes of adjustable length. The single fin is likewise of two-spar construction. In general, the structure of the tail unit corresponds to that of the wing. The elevator and rudder, like the aileron, are balanced through rear displacement of their hinges and by means of masses. In addition, they are equipped with trimming-tabs which are adjustable both on the ground and from the cockpit by means of wires and screw jacks. The effective control is carried out in the conventional manner by means of hand wheels, rudder pedals and rigid transmission members, whereby the control mechanisms of the co-pilot can be disconnected at will. An automatic pilot is foreseen.

Undercarriage

The undercarriage of the "Cormoran" comprises two main wheels and a twin nose-wheel. The main wheel retracts forwards and upwards between the engine and leading edge into the inboard nacelles. Because of the high-wing monoplane arrangement, the main shock-struts are over 14 ft. long and have to be articulated for retraction. The retraction mechanism grips a forward supporting strut which likewise features an articulation. The shock strut of the nose-wheel pair is situated forward and beneath the cargo-hold floor, and is folded upwards and forwards during flight into the nose section. In order to prevent any tilting to the rear of aircraft during loading or unloading operations, there is a retractable support fastened beneath the rear fuselage.



SPECIFICATIONS

Main dimensions

Span	144 ft. 4 in.
Length	100 ft. 1 in.
Height	33 ft. 2 in.

Fuselage

Main Cargo Hold	
Length	59 ft. 5 in.
Width	8 ft. 10 in.
Height	10 ft. 2 in.
Floor area	441 sq. ft.
Capacity	5,300 cu. ft.
Floor to ground	4 ft. 7 in.
Length of loading ramps	33 ft.
Upper deck luggage hold	
Capacity	approx. 400 cu. ft.

Wing

Area	2,150 sq. ft.
Aspect ratio	9.6
Thickness at root	18%
Thickness at tip	10%
Angle of incidence to cargo floor	8.5°

Tail unit

Elevator Unit	
Span	47 ft. 7 in.
Total area	430 sq. ft.
Fin and Rudder Unit	
Height	16 ft. 5 in.
Total area	226 sq. ft.

Undercarriage

Main wheel diameter	4 ft. 11 in.
Nose wheel diameter	3 ft. 1½ in.

Power plant

(Four S.N.E.C.M.A. — ex-Gnome & Rhône—14R air-cooled 14-cylinder twin-row radials)

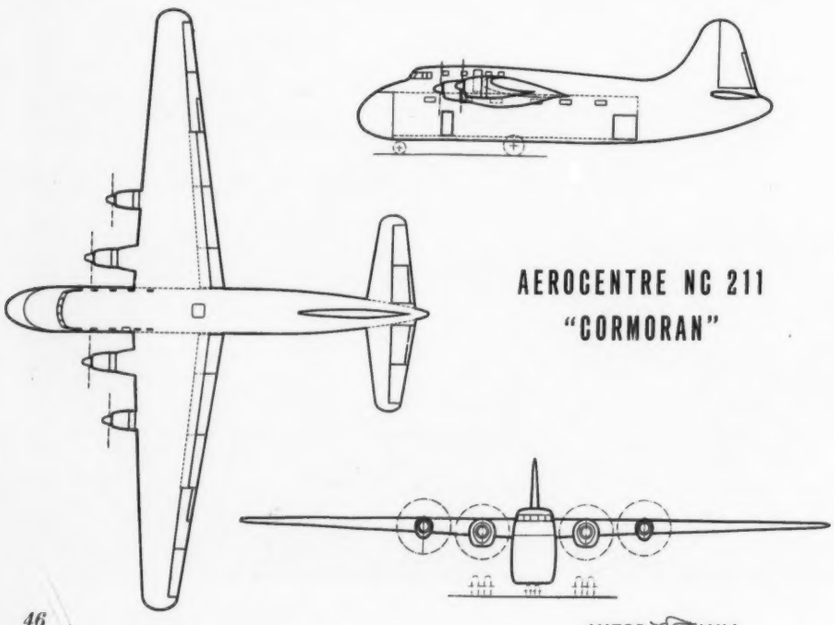
Take-off power	1,580 H.P.
Rated power at 10,000 ft.	1,310 H.P.
Cruising power	790 H.P.
Airscrew diameter	13 ft. 1½ in.
Max. fuel supply (12 × 146.25 Imp. gals.)	1,755 Imp. gals.
Oil supply (4 × 33 Imp. gals.)	132 Imp. gals.

Weights

Tare weight	50,500 lbs.
Disposable load	37,500 lbs.
Gross weight	88,000 lbs.
Wing loading	41 lb./sq. ft.
Power loading	14 lb./H.P.

Design performance

Speed at 10,000 ft. at rated power	250 m.p.h.
Speed at 10,000 ft. at cruising power	185 m.p.h.
Landing speed	80 m.p.h.
Take-off roll	2,300 ft.
Take-off distance over 50-ft. screen	3,650 ft.
Landing roll	1,475 ft.
Landing distance over 50-ft. screen	2,100 ft.
Service ceiling	28,000 ft.
Ceiling with one engine cut out	14,750 ft.
Range with full tanks against 30-m.p.h. headwind	1,250 miles



AEROCENTRE NC 211
"CORMORAN"

Australian Developments In Radar For Civil Aviation

Survey prepared by S. G. WILLIAMSON, Senior Airways Engineer,
and approved by R. Badenach, Director of Airways, Australian Dept. of Civil Aviation.

Australia's participation in the development of radar for civil aviation dates from January, 1944, when the first British Commonwealth and Empire Conference to discuss radio for Civil Aviation (First CERCA) was held in London. This conference was convened for the purpose of discussing the extent to which the latest radio and radar developments could be applied to the operation of civil air transport services and agreeing on a co-ordinated plan for the development of new equipment and for the standardisation of operating characteristics. Although it was realised that any standards must be agreed internationally if they are to be fully effective, this conference was limited to the British Commonwealth because of the time required to arrange an international conference, the inability of some nations to take part in such discussions at that time, and the urgent need within the British Commonwealth for an immediate plan for reorganising British air routes. It proved to be most successful and, with the other conferences which followed, worked out a series of standards and development plans which are proving to be of considerable assistance to the technical committees of the Provisional International Civil Aviation Organisation that are currently engaged in the determination of international standards.

2. The CERCA Conference agreed that the best and quickest results would be achieved by the various countries working concurrently and independently on the problems requiring immediate solution and comparing notes at regular intervals.

It also reached agreement on the types of radio equipment which are in most urgent need of development and specified the operational requirements for such systems. The part which Australia agreed to undertake as its contribution in this development programme is divided into two main projects—the development of a short distance navigational aid comprising a track guide and a distance indicator, and the development of a traffic control aid. This work has been carried out by the Radiophysics Division of the Council for Scientific and Industrial Research at its Sydney laboratories and has now reached the stage where full scale trials under actual working conditions are being undertaken by the Department of Civil Aviation. The track guide selected for development, which is known as the M.T.R. (Multiple Track Radar Range), provides a number of radial tracks leading to the airport, whilst the distance indicator known as the D.R.B. (Distance By Radar Beacon) gives a continuous indication of the aircraft's distance from the airport.

D.R.B.

3. The distance indicator is identical in operating principle with the ASV/ASV Beacon and Rebecca/Eureka combinations which were used widely by the British and Allied air forces during the war for distance measurement. The Australian development

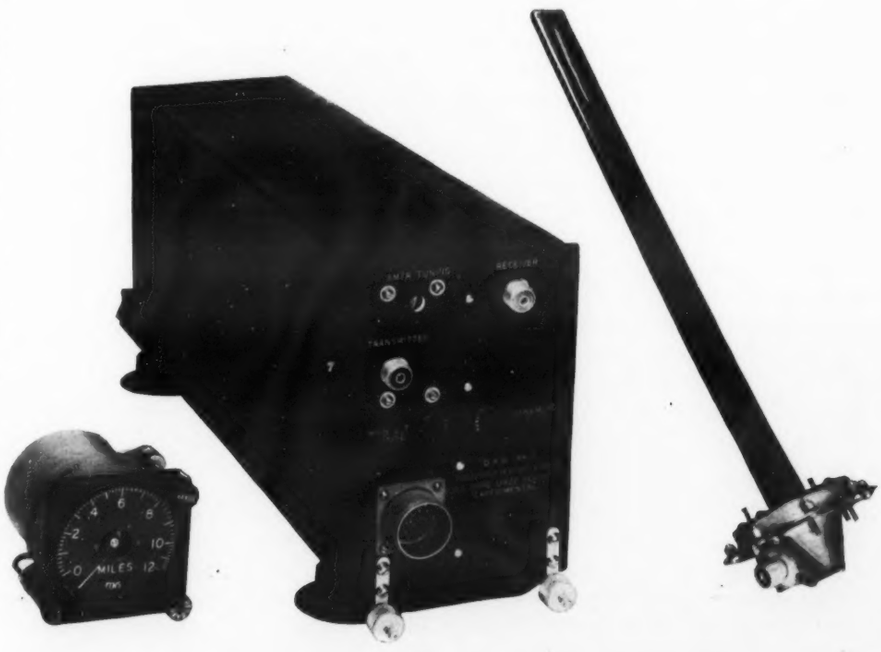


Fig. 1:
D.R.B. Airborne Equipment. Left: indicator; centre: transmitter-receiver; right: aerial.

Fig. 2:
Ground Beacon Installation at Essendon Airport.

work has been concentrated on reducing the weight and complexity of the airborne equipment and simplifying the method of presentation to the pilot. It has now been carried to the stage where prototype units have been produced, a chain of ground beacons is at present installed between Melbourne and Sydney, and some commercial aircraft are being fitted with airborne units so that airline pilots can check the system's performance under actual working conditions.

4. The airborne unit, which is shown in Figure 1, consists of a main unit, weighing 20 lbs. in its standard A.T.R. mount, and a pilot's control unit, comprising a meter type indicator giving a direct reading of distance in miles, a range change switch, a push button for releasing the automatic ranging circuit, and a neon pilot light. The operating frequency of the system is approximately 200 Mc/s and the maximum range obtainable is normally dependent on radio propogation characteristics at the frequency. A typical range is 80 miles at 4,000 ft., whilst the maximum range is approximately 120 miles. Two range scales, 0-12 and 0-120 miles, are provided and give measurements with an accuracy complying with the CERCA specification, namely, plus or minus 1/4 mile up to 12 miles, and plus or minus 2% beyond that range.

5. The sequence of operations is exactly the same as for any secondary radar system. The air-ground link consists of a small airborne transmitter with a peak power of 400 watts which sends out a stream of 2-microsecond interrogating pulses at a repetition frequency of 100 cycles per second, and a ground receiver with a sensitivity of 5 microvolts. The ground beacon, which is normally quiescent, responds after a delay of 20 microseconds with a 4-microsecond pulse having a peak power of 10 kilowatts. This pulse is intercepted by the airborne receiver and passed to the automatic ranging circuit which measures the time interval between each initiating airborne transmitter pulse and the response from the ground beacon. This time interval is displayed to the pilot on a meter calibrated in miles.

6. The automatic ranging circuit is the most important development in the equipment. It makes possible the use of a simple meter display in place of the usual cathode ray tube. After the equipment is switched on the needle of the indicator remains in the below zero position whilst the transmitter sends out its stream of interrogating pulses and the ranging circuit searches automatically for a response. When it locates a sequence of synchronised pulses it " locks on " to the signal, the needle moves to the correct range reading and the neon lamp in the corner of the control unit lights. Once every minute the ground beacon identification signal, consisting of two letters in Morse code, is transmitted by gap coding of the ground beacon pulses and is presented to the pilot as a flashing of this neon lamp. The automatic search is conducted in the direction of increasing distance so that the ranging circuit " locks on " to the nearest beacon. If, however, the pilot wishes to obtain a range on some alternate beacon, a touch of the release button in the corner of the indicator will cause it to continue to search for a more distant beacon in the direction of increasing distance. The meter reading is continually changed to the correct range whilst the signals continue to be received from the ground beacon, and a delay of about 5 seconds is provided so that any transient loss of signal due to fading will not cause the circuit to recommence its sweep.

7. Separate frequencies are used by the airborne and ground transmitters so as to avoid interference between adjacent stations. In its present form, the airborne equipment operates as a single pulse, single frequency unit : i.e. all aircraft transmit on the same frequency and each one of them triggers all ground beacons within its range. The traffic handling capacity of the system is, therefore, limited by the ability of an airborne equipment to identify the desired response to its own pulses from amongst the " clutter " of unwanted pulses. This " saturation level " occurs at 5,000 pulses per second with the present design, but, with current circuit developments, it is anticipated that a figure of at least 8,000 pulses per second will be achieved. Hence, if an aircraft should be within range of, say four ground beacons, the distance indicator will tend to become unworkable if each beacon is transmitting at a rate equivalent to being triggered by about twenty aircraft.

8. Figure 2 shows a typical ground beacon installation. The aerial system consists of separate vertical colinear arrays for transmitter and receiver. The ground beacon's characteristics and operating frequency have been suitably chosen so that, in addition to responding to D.R.B. fitted aircraft, it will also respond to the various types of Rebecca equipment which are widely used throughout the British air forces and transport services.

M.T.R.

9. The tracks of the multiple track radar range are produced by a pair of stations set 5-10 miles apart which operates on the same principle as the Gee and Loran systems. One ground station, known as the " master ", sends out a steady stream of pulses which are received by the aircraft and also by the second or " slave " station. Then, after a certain fixed delay, the latter transmits the pulses so that the aircraft receives two similar streams of pulses separated by a certain time interval. It is possible to draw on a map, a line representing a certain constant time difference between these two streams of pulses. By drawing a series of such lines on the map and giving the pilot an accurate indication of the time interval, he can immediately determine his line of position. These lines are actually hyperbolæ with the two stations as foci and, when the stations are located 5 to 10 miles apart, they become effectively straight radial lines at distances greater than about 10 to 20 miles. By locating the two stations on either side of the airport, a series of accurate tracks in two 120° sectors, as shown in figure 3, can be provided. It is usually possible to arrange these two stations so that the two sectors of tracks meet all normal requirements. However, if completely omnidirectional cover is required, it can be provided by adding a second master station which, with the slave station, will form a second track system, as shown in Figure 4.

10. The components of the airborne equipment are shown in figure 5. It consists of a receiver set to the common ground station

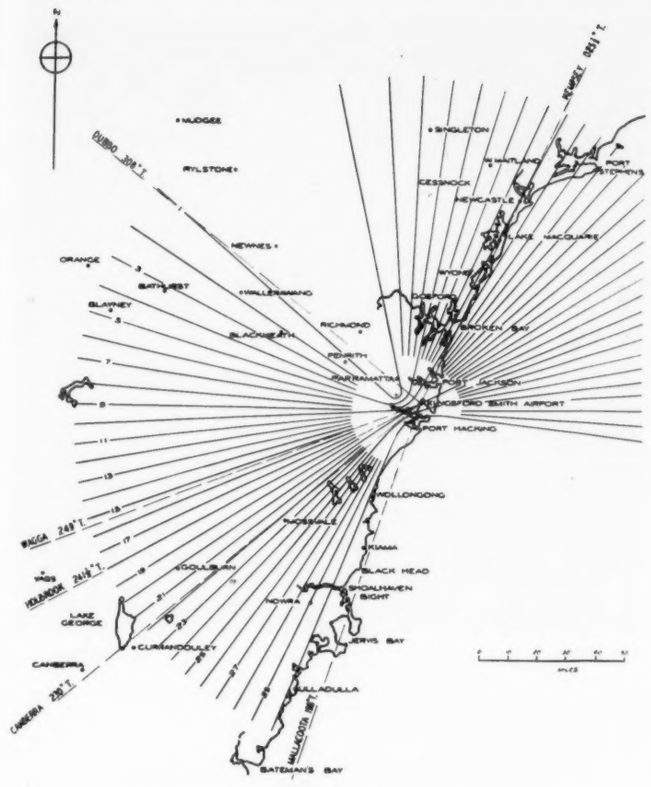


Fig. 3:
Plan of Sydney Area showing M.T.R. tracks radiating from a pair of ground stations.

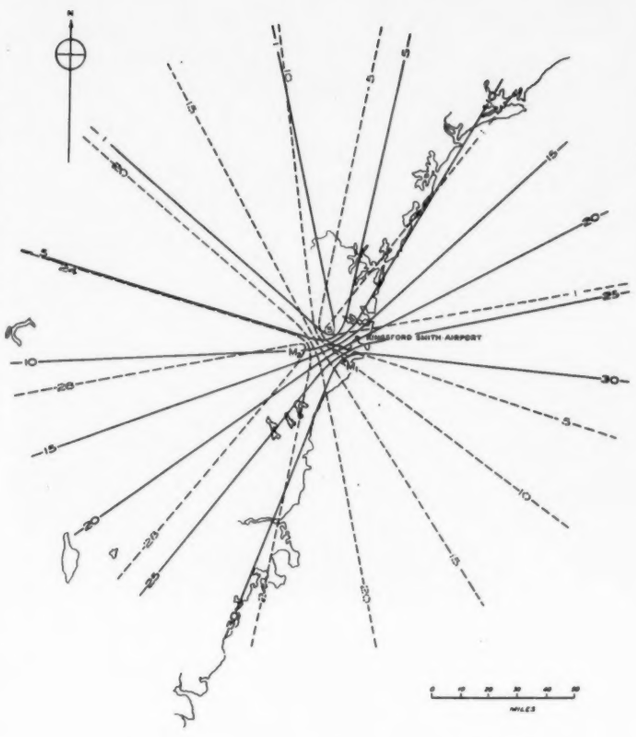
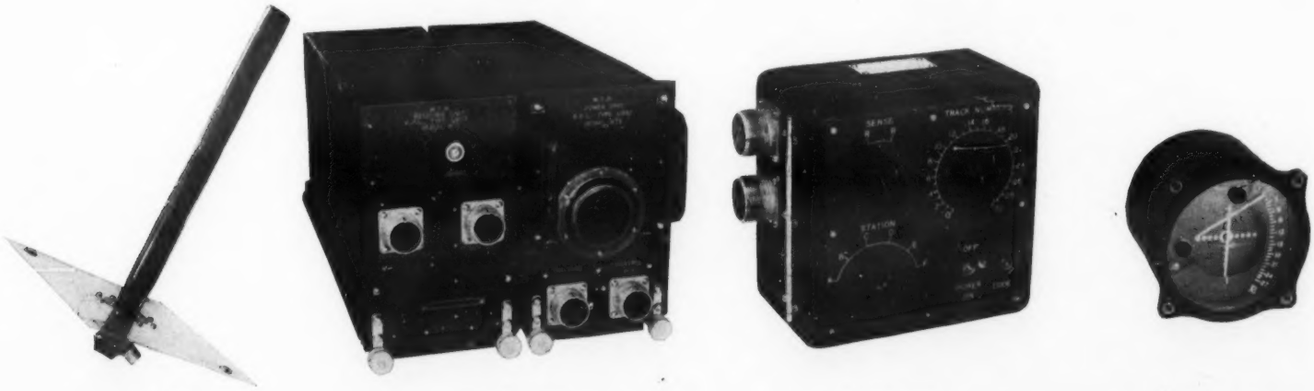


Fig. 4:
Same area as in Fig. 3 with two M.T.R. track systems.
M_1 : first master station ; — M_2 : second master station ; — S : common slave station

frequency (about 200 Mc/s) and a circuit which automatically measures the time interval and indicates it on a meter graduated in track numbers. These track numbers represent multiples of 3.33 μsec., No. 1 track being that line along which the time interval is 3.33 μsec. The total number of tracks obtainable depends on the distance between the master and slave stations and is usually between 15 and 30. All ground stations operate on the same transmitting frequency but adjacent stations have different pulse repetition rates so that any particular pair of stations can be selected by the pilot's setting the selector switch on the control unit. The equipment then searches automatically for the ground station in a manner similar to that described for the distance indicator and, when it " locks on " to the station, gives a continuous indication of the time interval on the horizontal pointer of the indicator, thereby giving the track number and a rough indication of the aircraft's position in the track system. By turning the track number switch the pilot can select a particular track along which to fly and departures from the track are then shown in a sensitive manner by the vertical pointer which operates as a left-right indicator.

11. In flying on the M.T.R. by means of the left-right pointer, the pilot sets a course and uses the gyro compass in the normal way. If the aircraft is initially off the chosen track the pilot flies the aircraft towards the pointer in the usual instrument flight sense until the



Aerial — Receiver — Control Unit — Indicator

Fig. 5:
M.T.R. Airborne Equipment

Fig. 6:
Daylight Plotting Unit at Kingsford Smith Airport.

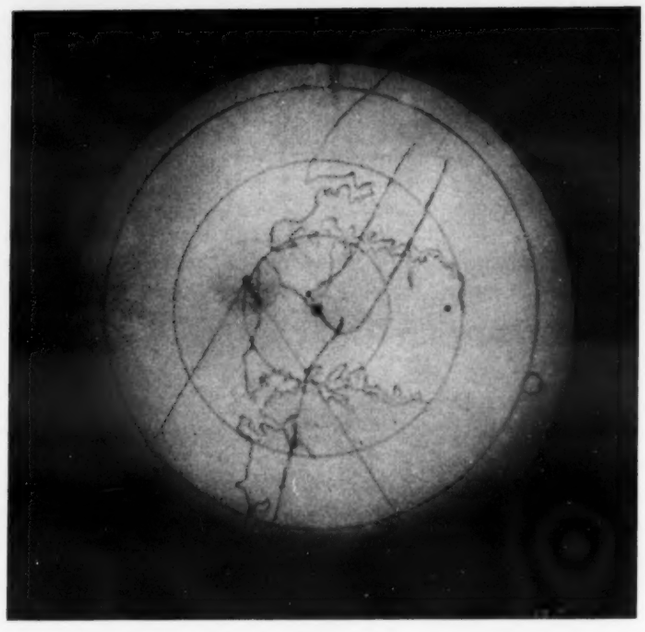


Fig. 7:
Daylight Plotting Unit at Kingsford Smith Airport; range circles are at 5-mile intervals.

pointer approaches the on-course position. The pilot must then correct his course and check occasionally on the pointer to see that the course being used is keeping it on centre. In practice it has been found that all pilots master this procedure very quickly during their first flight. Provision is made for a sense switch marked R-B on the control unit. The correct setting of this switch can be determined from the track maps supplied for any particular track system, but in any case a pilot would be aware of the wrong flying sense of the pointer in a few minutes' flying. One of the most important features of this system is its independence from site errors. Since the tracks are defined by the difference in time of propagation of radio waves, they are not affected by variations of amplitude or phase. Neither are they affected by echoes from objects on the ground nor from mountains, as the echoes always arrive later than the main pulse and are automatically eliminated.

12. This project has also been carried to the stage where prototype units have been produced and stations are being installed between Melbourne and Sydney to enable it to be checked by airline pilots. In addition, it was recently demonstrated at Ottawa, Canada, to delegates at the meeting of the Special Technical Division of the Provisional International Civil Aviation Organisation.

13. Although these experiments with the D.R.B. and M.T.R. equipments are being conducted on a frequency of approximately 200 Mc/s, this is being done purely as a matter of convenience and because, at the time when the projects were initiated, it appeared likely that such a frequency would be adopted internationally for navigational aids. The final form which these devices will take, will depend entirely upon the decisions made by the Provisional International Civil Aviation Organisation and this experimental work is intended merely as a contribution to the mass of detailed study required to enable sound decisions to be reached.

TRAFFIC CONTROL.

14. The equipment being developed for aiding traffic control is in two parts:

1) A short range primary radar equipment known as A.T.C. (Airport Traffic Control) for providing a picture to airport control officers of all aircraft within 20 miles of the airport at heights up to 4,000 ft.

2) A long range equipment known as A.W.C. (Airways Traffic Control) to provide a picture of all aircraft at normal operating heights within 120 miles of the control centre.

As the development of radar equipment suitable for these applications has already been carried to an advanced stage for military purposes, the Australian development work has been devoted to improving the method of presentation of desired information to the traffic controllers.

15. The equipment being used for the A.T.C. project is a modified military radar operating on a wave lenght of 9 centimetres with a peak power of 100 kilowatts. The aerial has a 12° vertical beam with a sharp cut-off below an elevation of 2° and is set at a height of approximately 3 ft. above ground so that it effectively covers the airport

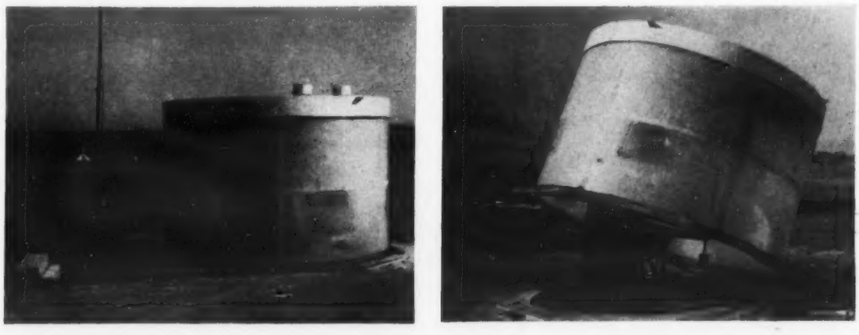


Fig. 8:
Local experimental A.T.C. installations at Kingsford Smith Airport, Mascot, Sydney. Left: perspex radome with counterweight; right: perspex radome tilted, showing 5-ft. reflector.

approaches at heights up to 4,000 ft. for distances up to 20 miles from the airport. The equipment is located on the boundary of Kingsford Smith Airport, Mascot, Sydney, N.S.W., at a distance of 600 yards from the control centre and signals are relayed by cable and V.H.F. radio link to a normal P.P.I. display in the control room. Aircraft plots are transferred from the display by means of a selsyn motor system operated by a trained radar operator and are presented to the airport controller as a series of dots on a sheet of white paper about 15 inches in diameter. These dots gradually fade away and disappear after about 15 minutes so that they show the direction from which the aircraft has come without unnecessarily

Fig. 9:
Experimental radar replotting equipment. Console with A.T.C. indicator and space for A.W.C. indicator; writing pen for electrical transmission of aircraft markings to the plotting unit in the control tower.

obstructing the picture. The " writing " on the paper is achieved by using a starch paper impregnated with potassium iodide and sodium carbonate and touching it with a positive electrode. Aircraft identification is obtained by normal communication methods. A view of the aerial in its perspex radome in shown in figure 8 and the radar operator's console is shown in figure 9.

16. The Airways Control unit is to be located on a prominent site in order to give adequate coverage and will have a peak pulse power of 500 Kw and a wavelength of about 10 cm. The aerial is 25 ft. high by 12 ft. wide at the middle and tapering to 7 ft. wide at the ends. Signals will be fed to the control room via V.H.F. radio links and aircraft plots will be transferred to a daylight viewing picture by the same operator who operates the A.T.C. unit.

Parachute Jumps at High Speeds

The problem of parachute jumping attained new levels with the advent of flying speeds of 400 m. p. h. and over, and especially since the introduction of jet aircraft. As it was possible to construct parachutes for speeds of about 250 m.p.h., it became necessary to find a device which would release the occupant from a fast-flying aircraft despite the air impact, without his risking injury from contact with the tail assembly. It was soon seen that a very powerful ejection apparatus was the only possible means of meeting these demands at any speed, aircraft position and altitude. The necessary ejection energy, which has to be available within a split second and fully effective during a short time interval, was easiest supplied by gas pressure release. Hence, the task arose to calculate the combustion process of an explosive cartridge in such a way that it would release energy in sufficient quantity to provide the velocity to carry a man outside the danger area, but in a manner such as not to cause him any injury. Ejection seats of this kind were used for the first time during the war in Germany in Focke-Wulf Fw 190 fighters. In Great Britain, it was the *Martin-Baker Aircraft Co.* which, at the end of 1940, took the idea up and began its own experiments in the spring of 1945. The question of the highest acceleration which the human body could resist without permanent injury was in no way settled at that time in England. The general opinion was that an acceleration of about 10G to 12G might be sustained for a very short period. However, in view of the limited space in aircraft for piston stroke,

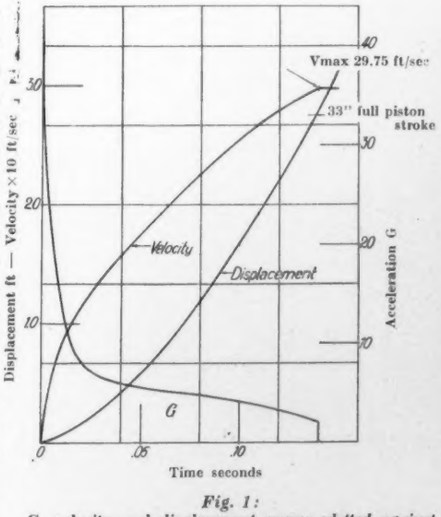


Fig. 1:
G, velocity and displacement curves plotted against time.

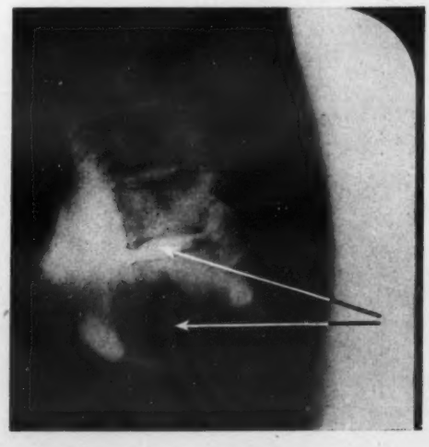


Fig. 2:
X-ray picture of a vertebra injury, caused by sharp curvature of the upper part of the body.

it was found to be impossible to eject a weight of about 260 lbs. without increasing this acceleration considerably.

Hence, intensive development tests were begun by Martin-Baker engineers with a 16-ft.

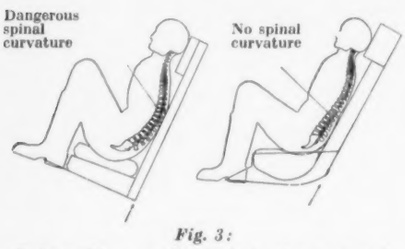


Fig. 3:
Body position according to foot rest arrangement.

test rig, in which loads of the already-mentioned weight were accelerated by firing an explosive cartridge. Fig. 1 shows the characteristic form of G, velocity and displacement curves plotted in relation to time. The G-values at the beginning of the process were so high, however, that it seemed impossible that ejection heights of over 15 ft. could be attained without bodily harm. During one of the early tests, one subject received injuries to the vertebræ, due to too sharp curving of the spine (Fig. 2). By lowering the foot rests, installed in order to relieve pressure under the thighs from the weight of the legs, it was found that ample clearance was provided between the vertebræ (Fig. 3). The outstanding improvement was obtained by a division of the combustion process into two phases: after the piston has covered about 10 in., a second explosive charge is exposed and fired by the hot combustion gases of the first cartridge, so that maximum pressure is obtained at the end of the stroke.

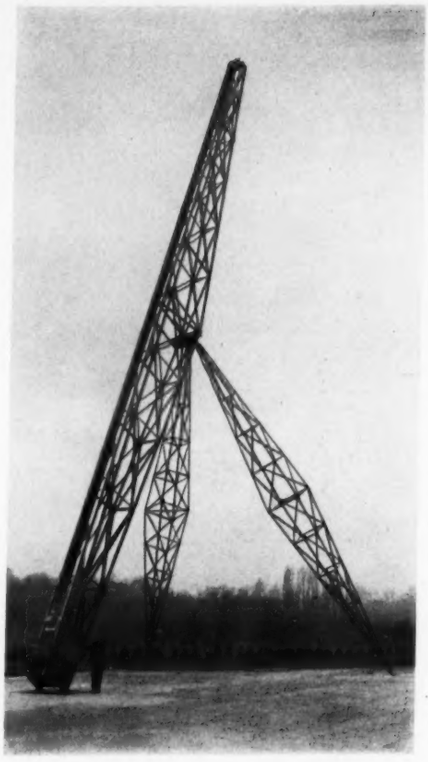


Fig. 5:
65-ft. test rig for ground trials.

The first ejection experiments from aircraft were made with a two-seater Boulton Paul "Defiant." However, the seat was loaded with a dummy for all tests, with a standard service supply Dropping Parachute attached to the seat. The parachute container was opened by a ½ to 3-sec. action device tripped by a static line. Fig. 4 shows a trial of this kind at 360 m.p.h.

The construction of a 65-ft. test rig (Fig. 5) allowed for the execution of a great number of tests with the improved, two-cartridge type ejection seat. No further injuries occurred to subjects, as it was soon recognized that the G-time curve, critical from a physiological aspect, could be subjected to very great variations without significant effect on the G-stroke curve, which decides the ejection height. As may be seen from Figs. 6 and 7, the G-time curve rises very gradually to its maximum while the G-stroke curve still approximates quite closely to the ideal rectangle.

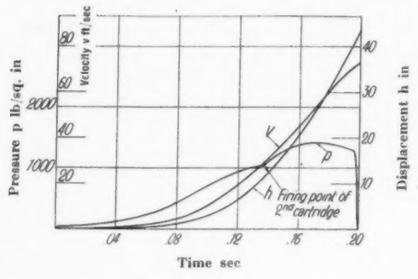


Fig. 6:
Gas pressure and piston velocity with double cartridge.

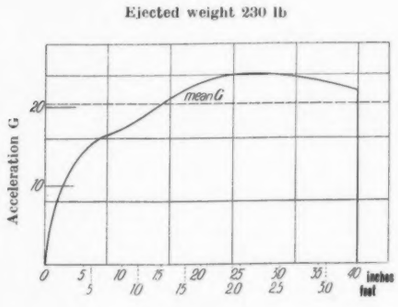


Fig. 7:
G curve with double cartridge ejection.

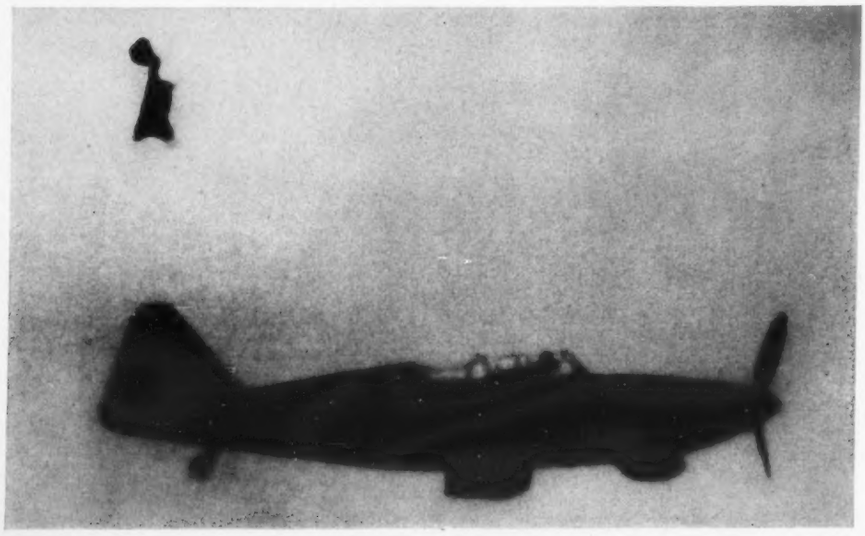


Fig. 4:
Ejection at 360 m.p.h. from a Boulton Paul "Defiant".

The aeroplane seat is a welded tubular framework consisting of the two side frames connected across the top by a strong arched beam containing the firing head and receiving the thrust from the piston. Four wheels locate the seat in the light alloy plate ejection ramp, at the base of which the cylinder is loosely supported in the abutement. Moreover, the top-end of the piston tube is mounted in the firing head on a spherial seating so as to avoid any binding of the piston-cylinder unit due to deflection of the seat structure during ejection (Figs. 8 and 9).

The seat and ramp form a contained unit, producing an extremely simple installation. A seat adjustment gear, developed by Martin-Baker, allows for four seat positions with a maximum movement of 4 in., whereby a positive lock is incorporated to fix the seat to the ramp in each case. Automatic unlocking when the seat is ejected is operated by the gas pressure.

Fig. 8:
Martin-Baker Explosive Ejection Seat: front view.

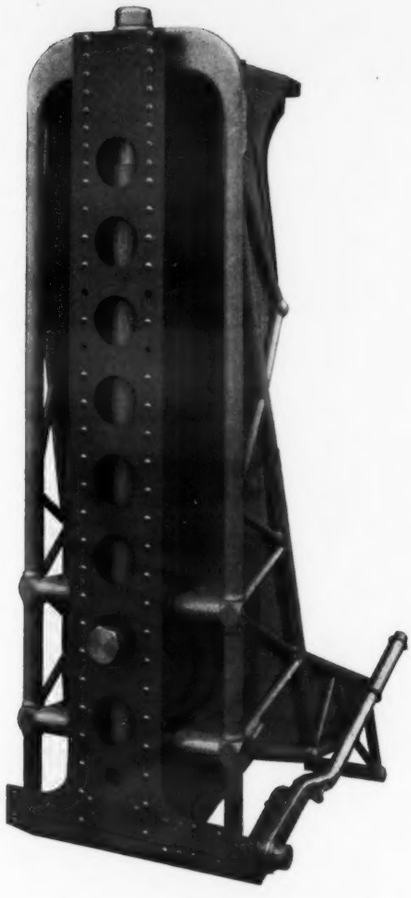


Fig. 9:
Rear view of seat with ramp.

Operation of the firing gear is effected by the occupant of the seat after jettisoning the cockpit hood, by pulling two handles above his head to their full extent (Fig. 10). This action draws out a face protecting blind and simultaneously withdraws the seat in the firing head, so firing the first cartridge. In order to ensure that the pilot does not foul the aircraft structure with his knees during the ejection, it has been found in most types of aircraft that the ramp has to be inclined backwards. The angle between ramp and vertical is generally found to be greater than the angle of the pilot's body fixed by requirements of gun sight and controls (Fig. 11). This difference in angle causes the head of the pilot to be jerked forwards. Hence, the blind is not only to protect the pilot's eyes and mouth against the air impact, but simultaneously serves to prevent sharp forward deflection of the head. The efficiency of this arrangement is clearly seen from the camera shots of trials, reproduced in Fig. 12.

In order to be able to carry out ejection trials at very high speeds, dummy loaded seats were installed in a two-seater special version of a Gloster "Meteor" jet fighter. Extensive testing enabled the most favourable method of parachute release to be established. Two schemes were developed. The first consisted of a drogue parachute anchored and contained at the top of the seat, the procedure being that, when the seat is ejected, the drogue is released from its container by a 15-ft. static line. The drogue prevents the seat from cartwheeling and slows it down rapidly. The pilot then chooses his time to jump from the seat and descend in the normal manner.

The second scheme is fully automatic and consists of a drogue parachute stowed on top of a main parachute in a container at the top of the seat. The two parachutes are connected by cable, this cable being attached by a drag controller to the top of the seat so that the pull of the drogue is taken by the seat, the main parachute remaining in its container. When the drogue has slowed the seat down to a specified speed, the drag controller

Fig. 10:
Operation of the firing gear.

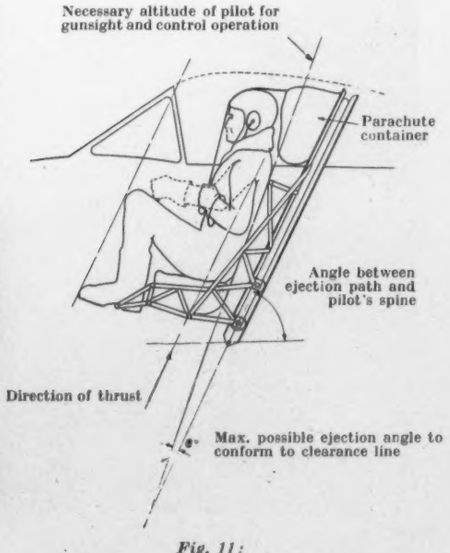
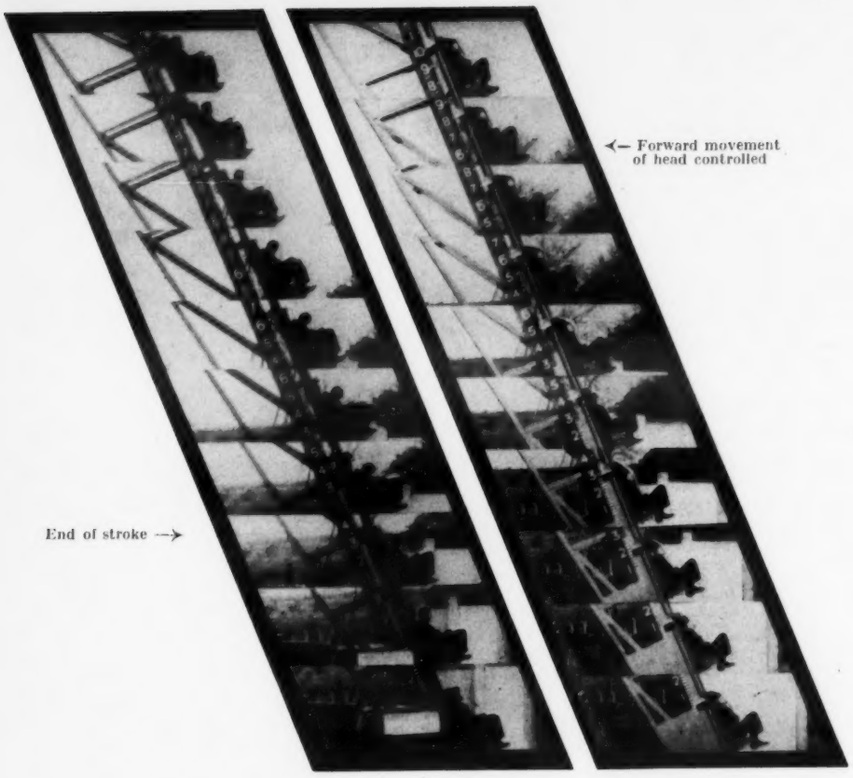
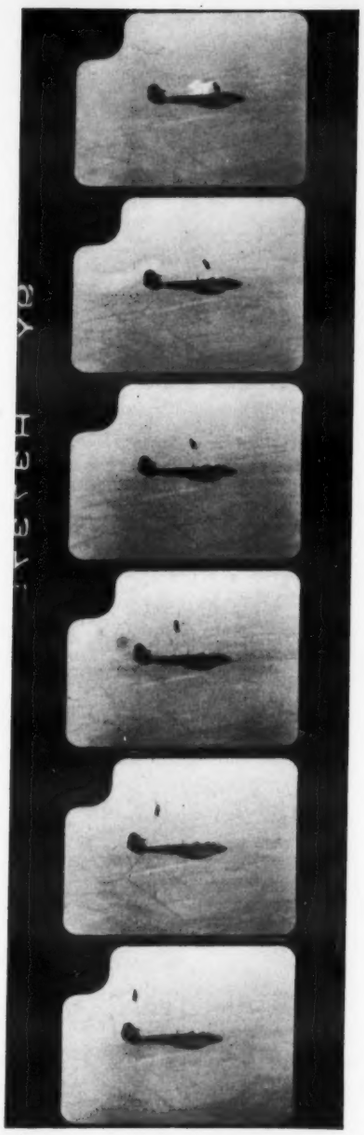

Necessary altitude of pilot for gunsight and control operation
Parachute container
Angle between ejection path and pilot's spine
Direction of thrust
Max. possible ejection angle to conform to clearance line

Fig. 11:
The angle of inclination of the seat is determined by the geometrical aspects of the cockpit.





releases its hold and the main parachute opens. If the pilot is unconscious or wounded, he glides to earth with the seat ; otherwise, he can release the seat from the parachute and descend normally. Camera shots taken of an ejection test with a Gloster " Meteor " (Fig. 13) show that the drogue's opening takes place outside the danger zone and uninfluenced by the slipstream.

Fig. 12 :
Camera shots of trials with and without protective blind.

Fig. 13 : →
Drogue release after ejection of seat from a Gloster " Meteor ".

Fig. 14 :
The Americans have acquired a Martin-Baker test rig and are at present carrying out extensive experiments.

On July 24th, 1946, the first successful live ejection took place in England from a " Meteor " at 8,000 ft. and 300 m.p.h. Martin-Baker ejection seats are to be installed in all jet equipment of R.A.F. Fighter Command and are at present being subjected to exhaustive tests in the U.S.A. (Fig. 14).

It may be assumed that the ejection systems so far developed only represent an intermediate stage. .As soon as improved jet aircraft are introduced and altitudes of 46,000 ft. attained, which would scarcely be possible without pressurized cockpits, it will be necessary to eject not only the pilot but also the entire cockpit from the aircraft. However, it may be taken for granted that the devices to meet these requirements will work on the same principle as the ejection seat built today by Martin-Baker Aircraft Co.

Bi.

Why no All-Weather Flying?

by General Milton W. Arnold,
Vice-President, Air Transport Association of America

General Milton W. Arnold, born in 1907, graduated from the U. S. Military Academy at West Point and has served as a regular officer with the U. S. Army Air Forces since 1933. During the war he commanded fighter and bomber units over France and Germany, and was later assigned to Air Transport Command as Chief of the Weather Section. He was Acting Chief of Staff, A. T. C., with the rank of Brigadier-General when he resigned in January, 1946, to assume the office of Vice-President, Air Transport Association of America.

All-weather flying is already a reality for at least one transport plane in the United States. That is the private plane of the President of our country.

The ability of this aircraft to meet its assignments when weather is so bad that airlines are grounded makes people wonder whether President Truman isn't taking risks. It also causes speculation as to why commercial airlines cannot yet do so well.

The President does not travel by air unless it is perfectly safe. There can be no doubt of that, as I well know from my wartime service on the staff of the Army Air Forces' Air Transport Command, which operates the presidential sky-liner. It is also true that the commercial carriers still have to cancel some flights for the safety of passengers whose lives aren't considered quite so precious as the life of the President of the United States.

The reasons for the difference serve dramatically to explain why the airlines and the government are expending hundreds of thousands of dollars and priority effort to conquer storms and fog. These same reasons also give assurance that all-weather flying is just around the corner for all air passengers.

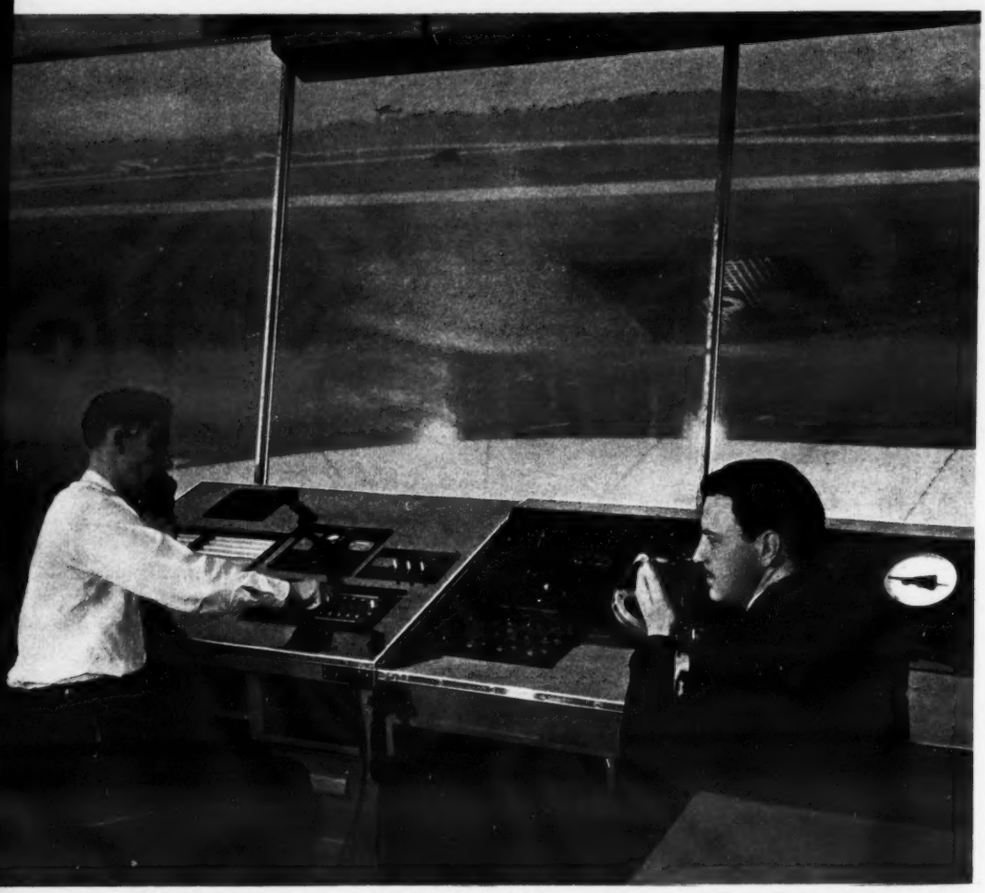
The President's plane is a C-54, essentially the same model which is coming into wide use on the airlines, but it has certain advantages which it is still too soon after the war for the airlines to install for general use. These instruments and methods soon will be standard in airline operations and I foresee the day, not far off, when instead of worrying about the President's safety, ordinary citizens will be making their own air trips, even if the President is flying when the weather is so bad that the crows are walking.

The foremost condition which the President's pilot, Col. Henry T. Myers, has singled out as giving him confidence to fly the President in most any weather is the fact that the "Sacred Cow" — as the plane is called — has four engines. The airlines flying overseas had this reserve of power and safety in flying-boats before the war and have it in the so-called landplanes which they are all using to cross the oceans now. One domestic airline had been flying four-engined Stratoliners across the continent before the war and resumed their use as soon as it recovered the planes from Uncle Sam after the war. The addition of four-engine craft to domestic schedules in any numbers only started last February. By mid-summer the number had passed the 120 mark. Soon reconverted military and brand new four-engine aircraft will be in operation on most of the longer runs in this country, as well as overseas.

Now for the instruments. Col. Myers and other pilots have landed planes in practice landings under zero-zero conditions, which means no ceiling and no visibility; except their landings were even blinder, because they had hoods pulled down over the cockpits so as not to be able to see a thing. But as of today they wouldn't want to do it with a load of passengers. The situation now is "almost, but not quite". The blind-landing instruments and other new navigational aids are a miraculous war-born development. I view them right now as of immeasurable value, one as a check against the other and against the pilot himself, yet not widely enough tested and installed for immediate, widespread civilian use. The day is right at hand, however, and a little patience is all that is needed before undreamed of marvels of air travel will be a reality.

It won't be longer than a quick tomorrow before these all-weather landings will be per-

The "Sacred Cow", Douglas C-54 four-engine transport in which President Truman undertakes his trips by air.



Inside view of control tower at CAA Experimental Station, Indianapolis. Radar receiving equipment visible on left of photo.

Outside view of Indianapolis control tower, showing part of experimental antennae for radar and VHF equipment.

formed quite generally by the airlines. Certain of the commercial carriers already have some of the super special instruments carried in the President's plane. The airlines, the Army and Navy, and the Civil Aeronautics Administration are rushing experiments to work out practical use of the instruments which were so rapidly developed during the war. Our Air Transport Association has a committee coordinating all the efforts and with each airline sharing the advances it develops of its own initiative. The ATA also has its own plane and its own experts working on the problem. States and cities at the same time are hurrying to provide bigger and better airports, runways and equipment to permit use of these instruments on a mass travel scale.

It's one thing to have instruments which perform marvels — fly a plane more steadily and surely than human hands and mind could do — but it is another thing to get them installed widely enough around the country and operated efficiently enough both on the ground and in the air to be foolproof. Air travel has zoomed to great heights because it has been so nearly foolproof and to my mind it is going even farther because the men guiding it are determined to keep it foolproof. That has been demonstrated in the remarkable accomplishments of the Army Air Forces Transport Command, which during the war had the services of most of the airlines under contract.

The instruments to do the job are here. They'll be improved, of course, and there will be new devices which we haven't dreamed of yet. But our ATA experience convinces me that we have the stuff to do the trick right now if it could be used widely — which it can't be, overnight. If the "Sacred Cow" can do it, the airlines can. And they are doing everything possible to reach the goal as soon as possible.

Take airborne radar, for instance. I think it is so important as an aid to safety — and reliable schedules — that transport planes in the future will be equipped with radar instruments. Yet there still isn't one in the President's plane, even though it works. It was responsible for the success of the high-altitude bombings of Germany, the Normandy invasion and later the Pacific bombings and landings.

The reason there isn't one in the "Sacred Cow" is that you would have to rebuild entirely the nose of the plane to install a set so that it would work well. The C-54 was due soon to be replaced by a DC-6 — a bigger and better aircraft of the same general design. If Uncle Sam doesn't think it feasible to sink money in an immediate radar installation for the President, you certainly wouldn't expect the airlines to put millions into the same project for many planes, when they too are soon going to get brand new aircraft.

This type of radar, which is carried in a plane itself, is a mighty useful gadget. It means more safety, principally ; and, of course, more safety

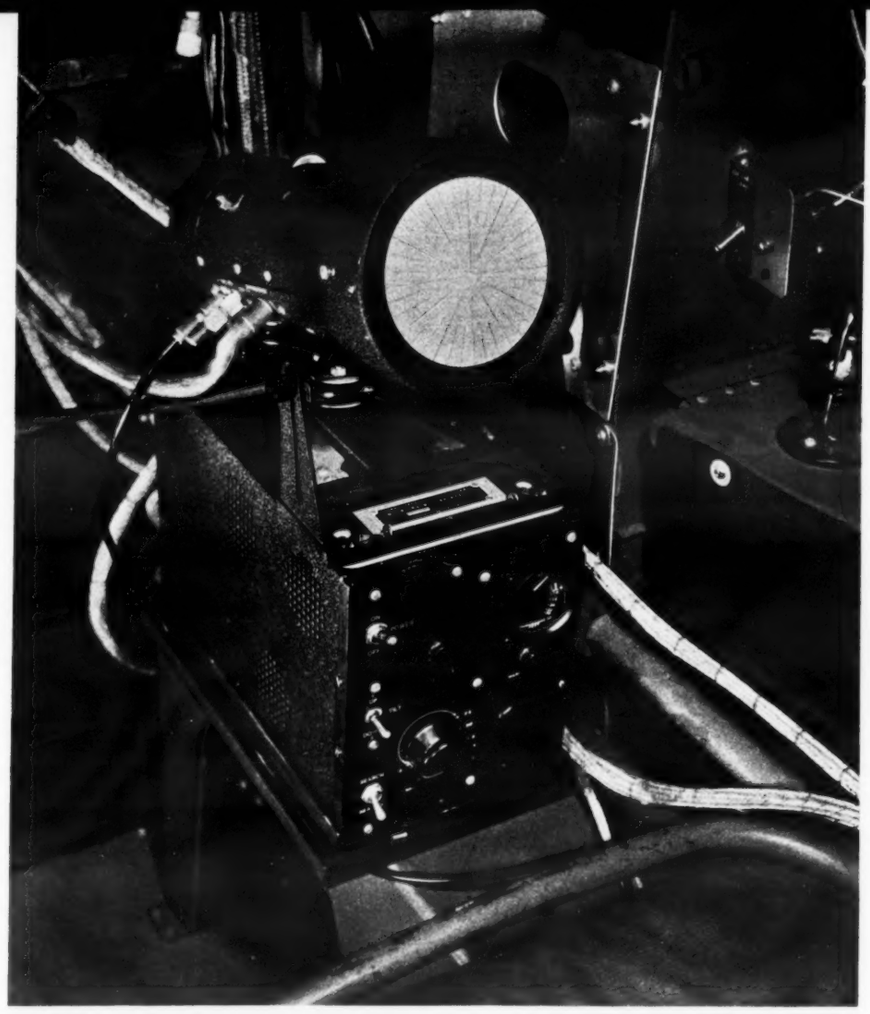
means you will be able to make more trips under worse conditions than you ever could before, yet be absolutely sure you will get to your destination without a scratch. This is the instrument which flashes on a screen in the cockpit a picture of all objects within at least a 4-mile range. Regardless of clouds, it shows the terrain below; it shows mountains ahead; it shows other planes in the vicinity, even at night, in fog, or snow, or rain.

Take the case of mountains. Your altimeter tells you how high you are. You're supposed to know how high the mountains are around you, but in unusually soupy weather, or if some instrument has gone wrong, you're sometimes not exactly where you think you are. I'd rather know when a mountain or something higher than my own altitude was right ahead of me than know how high I was over the ground — or was supposed to be. The radar scope tells you the former.

This airborne radar even registers thunderstorms far enough ahead so you can go around them. Without such a set, the weather reports might influence you not to attempt a trip when line storms were covering an area on your route. But with the radar, you could take off, confident that you could pick your way safely; and, in the opposite situation, assured that unreported or unexpected disturbances wouldn't take you by surprise.

Although this instrument's chief value for transport flying seems to be as a warning device (planes equipped with it would have no excuse for meeting disaster against the Empire State Building), it can be of considerable use in getting lined up for blind landings in combination with the other instruments more directly intended to aid landings. That is particularly true in cases where bodies of water are adjacent to airports, for the radar most clearly shows up the difference between land and water. This proximity exists at many of our principal airports, as for instance, at the Washington National Airport, at LaGuardia Field in New York, at Boston, and at numerous others. The radar scope here in Washington would give a perfect picture of the airport alongside the Potomac and provide enough check to get into your glide path beam if you had had any difficulty in doing so. Seconds count.

Going back to the altimeter. There is a radar altimeter on the President's plane which proved its usefulness when Secretary of State Byrnes was flying home in it from the first Foreign Ministers' conference in London. Returning from Newfoundland, they hit a hurricane area. In no time at all the barometer went down to 28.1. In an hour's interval the old style altimeter, dependent on atmospheric pressure, changed 1,100 feet. It didn't seem possible that the plane's altitude had changed much, yet in regions like that there are few check points from ground stations. It was a simple matter to reset the regular altimeter accurately by the radar altimeter. The latter bounces a beam to ground or water underneath and back again to the plane, giving you your exact height above whatever is under you — not your sea level altitude (unless the surface underneath happens to be the sea itself) but the altitude of the hill or plain or buildings, or whatever is highest below you. It is so accurate that when you fly over New York or any big city — which you shouldn't do deliberately — the needle pops up and down in response to the height of the individual skyscrapers. That Newfoundland incident is an extreme case, but it is easy to imagine how a few hundred feet variation could mean the difference between life and death.



Control unit and cathode ray tube of a radar set on the CAA experimental plane. This arrangement watches over the area in front of the plane in order to avoid collisions.

The principal instrument on the "Sacred Cow" which not many of the airlines yet have, is the so-called blind-landing radio. The necessary ground installations exist on a number of major civilian airports and have been standard on most big Army airfields. Intensive tests are being made to put it into widespread use, practical for everyday operations.

This is known in the Army as SCS 51. It works in conjunction with the regular range approach system used every day by the airlines. You come in over the range and the fan marker beacon and then swing over about eight miles out from the airport until you strike the runway localizer beam. At the Washington airport this is set up for only one runway, depending on the direction of the wind. The runway localizer sends out a beam from the ground which moves two needles on a special receiver in the plane, one horizontal, the other vertical. Once the plane picks up the beam, the pilot can tell by the needles whether he is gliding in too steeply or not steeply enough, and whether he is going too far to the right or to the left. By correctly following the movement of the needles he can come right down to the ground at the spot where he is supposed to. The glide path approach for a blind landing is a great advance in all-weather operations when it is used in team work with the other devices which can tell you where you are — even down to the last drop.

The ordinary range approach which has been in regular commercial use, guides you laterally without any trouble. You have to rely on your own altimeter to tell you just how high you are as you come down. Also, the range system won't tell you just how far you are from the station after you have passed — or missed — the radio cone sent

up by the marker beacon. The localizer and glide path system is a big improvement — or double check on this, as the beam keeps you just the right height at the right distance from where your wheels should touch the runway.

You hear a great deal about GCA now. That is Ground Control Approach. It is the pure radar way of coming down. That doesn't require any special instruments in the plane at all, just the ordinary radio receiver. Incidentally, there are five sets in the President's plane, just in case. All the radar is on the ground. And that is the trouble. At least it is plenty of trouble so far. The Army and Navy have made thousands of landings using the GCA, but there are many practical difficulties in the way of its civilian use. Heretofore, the apparatus hasn't been available. Now the hitch is that personnel to run it may not be available. The whole thing depends on the ground crew "talking" the plane down, whereas seasoned pilots have a natural distrust of relying solely on some unknown men on the ground to tell them just how many feet to go up or come down, right or left, when the pilot himself cannot see the ground at all. Most commercial pilots prefer to see light on the runways, and, to be sure, tremendous advances are being made in lights which will penetrate fog and clouds.

But before going into the pros and cons on this hot aviation controversy as to the best landing system, just how does GCA work? The radar apparatus is all on the ground. It comprises several radar scopes which follow the plane at various distances from the field and in various attitudes vertically and laterally in relation to the runway. The first scope to be used can follow the movements of all planes within a radius of 30 miles. The pictures keep steadily coming in, showing how far the plane is from the runway, how far to one side or the other it is, how high it is. The operators of each scope relay their information to the

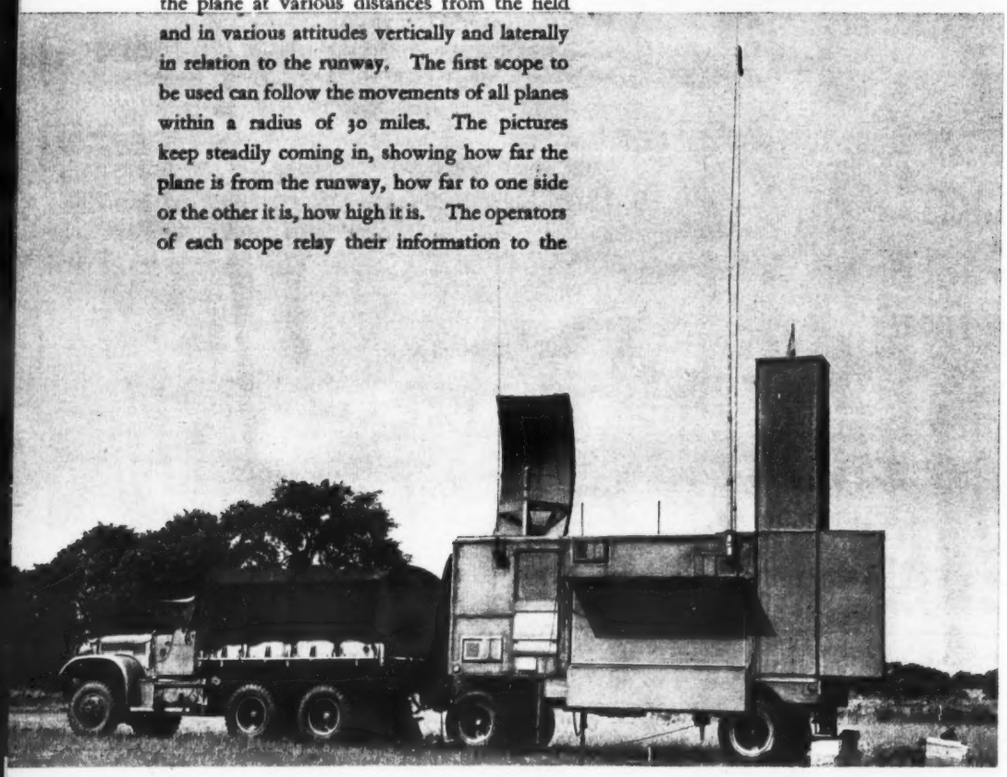
Rotating antenna of airport radar set to control approach area.

"final director", who follows its elevation and angle of approach and transmits verbal instructions which are received over regular radio loudspeaker or earphones by the pilot. The aircraft beaks into the clear right over the runway. Usually the pilot makes the final landing visually, as absolute zero-zero conditions are comparatively rare. But with this system many pilots have come down when they couldn't see a thing, even rolling right on to the runway without anything visible at arm's length.

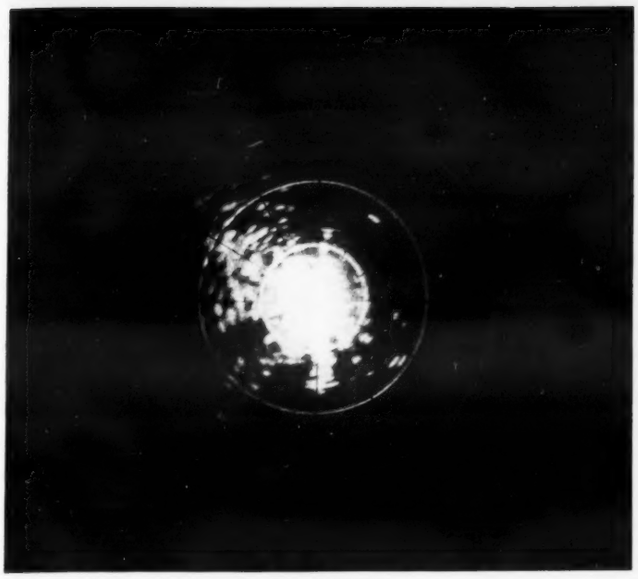
The difficulty in applying the method to commercial operations at once is not a technical one. These landings can be made and have been made thousands of times. But the ground crew must be composed of highly trained specialists. The job is not simply a question of turning dials and making readings. The skill required resembles the difference between a golfer who shoots 18 holes in 80 and one who can't do better than 100.

Each ground crew requires at least five of these "pro's". At a recent "all weather" conference sponsored by the Army in Washington, several manufacturers described coming developments which would simplify the apparatus, reducing the size of the crews. But that is still in the future. Now, at any given airfield, there might be only three days a month when the weather would be thick enough to necessitate GCA landings. Yet entire cross-country schedules might be disrupted if planes could not land at a particular field, and no one can tell when those three soupy days are going to occur. The radar crew must be on duty 30 days a month and 24 hours a day. Multiply a five-man crew by three shifts and that means fifteen men at every principal airport in the country. There are already more than 450 certificated airline stops in the United States. If the system were to be comprehensive, that involves roughly 6,100 operators or something like $ 30,000,000 in salaries per year. It is a question whether you could find enough men sufficiently trained and skilled. The Army has been discharging its experts and the chances are they will have been settled in other jobs long before the system is widely enough established to give them civilian employment. It is a problem, too, as to who (airlines ? government ? communities ?) would pay for such a huge payroll for necessarily part-time duty.

I don't wish to seem too pessimistic. The system is extremely valuable in combination



Mobile GCA (Ground Control Approach) ground station, as used by the AAF during the war.



Characteristic luminous patterns on a radar screen.

Operator at cathode ray screen of a GCA ground station.

with other methods. It will probably be improved so that present obstacles will someday seem minor. I simply feel that people should not expect too much, too soon.

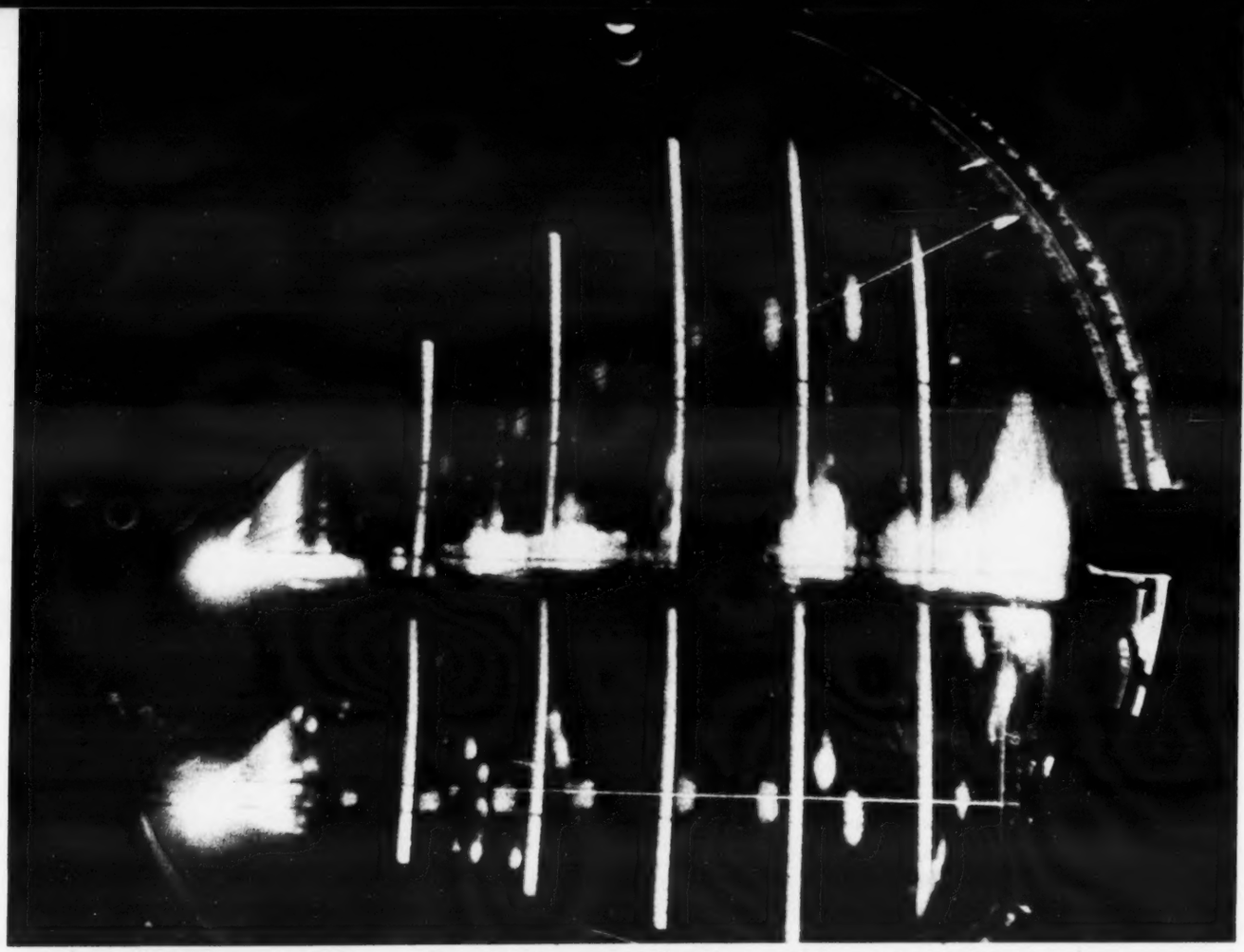
Another instrument which some commercial planes used when flying for the Air Transport Command and the Naval Air Transport Service (NATS) under contract during the latter part of the war, and which most of them are using on over-ocean flights now, is Loran. There is one on the President's plane and I imagine it will be used to some extent on longer domestic flights, because a transmitting station has already been installed at Kansas City.

This is the form of radar used for long range navigation. Transmission is made by a chain consisting of a master and two slave stations. The master transmits a pulse which triggers a slave station which in turn transmits another pulse after a fractional time delay. The time delay remains fixed, but the two signals radiate at constant velocity. In the aircraft, a receiver picks up and reproduces these pulses visually as "pips" on a scope tube. The navigator, seeing these lines of lights with bends in them, can determine his own position by calculations. From one "master" and "slave" chain he can determine his line of position — or what direction he is from the originating station. By picking up the pulses from a third he can get an accurate fix of exactly where he is. The navigator can plot a Loran fix in less than 3 minutes. There are about 50 such stations already, including seven spanning the Atlantic, while more installations are proceeding over the Pacific. Inasmuch as the range of any station is at least 1,500 miles, the entire world network of air routes can readily be covered by 140 stations and half that number when the range is doubled by coming improvements.

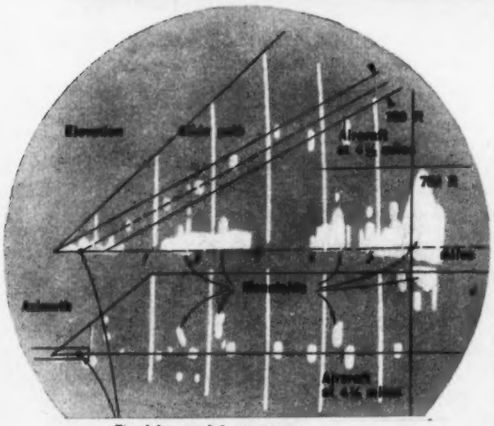
The advantage of this form of navigation is that the navigator can get his bearings even if storm clouds shut out the stars; by daylight, when no stars are visible (the sun is not too good to shoot for aerial celestial navigation); or in weather so bumpy that it is virtually impossible to get a shot of a celestial body with a sextant. Naturally, anything that makes navigation accurate 24 hours a day regardless of conditions brings us one step nearer to genuine all-weather aircraft operations.

One important factor which enables the President to make trips sometimes when the regular airliners stay on the ground is that on his special trips the plane carries enough gasoline to come clear back to where he started from, or go hundreds of miles to some other field, if weather has shut down too heavily at the original destination. The airlines wisely follow the same policy, carrying

One man can service the latest GCA equipment; only one aircraft can be "talked down" at a time.



Picture obtained by repeated recording of signals on a GCA screen during a plane's landing. The *upper part* represents the *lateral view* of the landing procedure; the inclined strip corresponds to the glide path and can be adjusted in elevation according to the type of plane. The vertical, white strips represent 1-mile distance intervals. The *lower part* of screen gives a *plan view* of the approach path. The white patterns above the horizontal line indicate hills and obstacles in the approach path.



Touchdown point on runway

hundreds of gallons of spare gasoline for a wide choice of alternate fields. But it is a question of degree. Naturally, if the weather reports indicate they might have to go too far out of their way, the airlines are not going to start the flight even if they know no danger would be involved.

Although it is simple arithmetic, I don't believe that as yet most people realize the situation, when they read about cancelled schedules; or appreciate it, when they experience a cancellation themselves. It is easy enough to carry thousands of gallons of extra gas if you have only a dozen or so V.I.P. (Army for Very Important Persons) on board, bound for a single destination. Passengers are sometimes indignant when they are denied airline passage and see empty seats. That is usually to allow for extra gasoline. Each 30 gallons equals the weight of one passenger. Empty seats sometimes, therefore, mean a margin of safety — but they also mean an empty cash register. If there are too many empty seats, no airline can keep running. Either there would be no air transport system such as we can boast of as the world's best today; or it would be running on government subsidy and not flying on its own financial wings, as it does.

Then there is the question of airways. The airlines are not allowed to deviate substantially from their routes. If bad weather makes it necessary, I can go to Los Angeles by way of Montreal. In crossing the continent I often switch back and forth along the routes of three different airlines.

The airlines can carry paying loads and enough gasoline for a safety margin now for all except the very worst weather. That very worst weather is the final hurdle and one that also will be cleared before long.

To be sure, there are the regulations of the Civil Aeronautics Board prohibiting commercial landings in most places when there is less than a 500-foot ceiling or two miles visibility. You can land the biggest aircraft perfectly safely with a 200-foot ceiling and a mile visibility. But I wouldn't want to do it with all the traffic at big airports, the enlargement of which hasn't been able to match the tremendous growth of flying. That is one reason why Col. Myers actually prefers flying the President's plane when the airlines are grounded. He has the sky and the airports to himself.

I don't mean to criticize the CAB standards. Safety is the first consideration for anyone travelling by air. In the war, Army and Navy pilots have taken off and landed when conditions were close to zero-zero and when the airfields were more congested than the busiest civilian terminals. But they had to do it. Planes and men, sad to say, are expendable in war. That doesn't hold true in civilian operations.

The day is coming soon when the President will never enjoy the luxury of having the airways to himself. That will be the day when we really have conquered Old Man Weather!

Official Bulletin of the F.A.I.

FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE

Meeting of the General Council of the F. A. I.

The first session of the General Council is to be held at 10 a. m. on Tuesday, January 21st, 1947, on the premises of the Aéro Club de France (6, rue Galilée, Paris).

The F. A. I. Gold Medals for 1946 are to be awarded to winners on this occasion.

1947 Sporting Flying Calendar.

Affiliated aero clubs are reminded that the General Secretariat of the F. A. I. should be informed as soon as possible of the dates on which they are holding their air rallies in 1947.

Customs Carnets.

Whilst awaiting the introduction of Customs Carnets in Norway (cf. F. A. I. Bulletin in "Interavia, Review of World Aviation", N° 8/9), private fliers desiring to fly to or over Norwegian territory should apply beforehand to the Norwegian Foreign Office for permission. Normally, this formality will require only a few hours.

Records homologated by the FAI

CLASS C

Payload : 1,000 kg. Altitude Record (U. S. A.).

Major Finlay F. Ross, Pilot ; Lt. Dougall M. Davis, Co-Pilot ; Crew : Lt. L. B. Barrier, Lt. G. B. Webster, F/O. P. Morrissette, Sgt. W. S. George — (all USAAF).

With a Boeing B-29 mid-wing monoplane powered by 4 Wright R-3350-23A engines of 2000 H.P.

Guam, 16th May, 1946. *14,603 m.*

Payload : 2,000 kg. Altitude Record (U. S. A.).

Col. E. D. Reynolds, Pilot ; Capt. Brian P. Robsen, Co-Pilot ; Crew : Lt. J. G. Barnes, Lt. Th. Madden, Lt. K. H. Morehouse, S/Sgt. W. C. Flynn, Cpl. A. L. Lentowski — (all USAAF).

With Boeing B-29 mid-wing monoplane powered by 4 Wright R-3350-23A engines of 2,000 H.P.

Guam, 13th May, 1946 *14,180 m.*

Payload : 5,000 kg. Altitude Record (U. S. A.).

Lt. John P. Tobison, Pilot ; Lt. Lloyd A. Lee, Co-Pilot ; Crew : Lt. D.B. Gleicher, Lt. A. W. Armistead, Lt, R. M. Beattle, Lt. E. J. Joyce, F/O R. F. Johnson, Capt. M. R. Genta — (all USAAF).

With Boeing B-29 mid-wing monoplane powered by 4 Wright R-3350-23A engines of 2,000 H.P.

Guam, 14th May, 1946. *13,795 m.*

Payload : 10,000 kg. Altitude Record (U. S. A.).

Capt. Arthur A. Pearson, Pilot ; Lt. V. L. Dalbey, Co-Pilot ; Crew : Lt. R. S. Strasburg, Lt. I. F. Bork, Capt. J. T. Collins, Capt. J. Friedberg — (all USAAF).

With Boeing B-29 mid-wing monoplane powered by 4 Wright R-3350-57 engines (with fuel injection) of 2,000 H.P.

Harmon Field, 8th May, 1946. *12,668 m.*

Payload : 15,000 kg. Altitude Record (U.S.A.).

Col. J. B. Waren, Pilot ; Major J. R. Dale, Jr., Co-Pilot ; Crew : Lt. W. D. Collier, M/Sgt. GS. Fish, S/Sgt. T. H. Hall — (all USAAF).

With Boeing B-29 mid-wing monoplane powered by 4 Wright R-3350-57 engines (with fuel injection) of 2,000 H.P.

Guam, 11th May, 1946. *12,046 m.*

Highest payload flown to an altitude of 2,000 m. (U. S. A.).

Col. H. B. Waren, Pilot ; Major J. R. Dale, Jr., Co-Pilot ; Crew, Lt. D. W. Collier, M/Sgt. G. S. Fish, S/Sgt. V. H. Worden, Sgt. T. H. Hall — (all USAAF).

With Boeing B-29 mid-wing monoplane powered by 4 Wright R-3350-57 engines (with fuel injection) of 2,000 H.P.

Guam, 11th May 1946. *15,166 kg.*

WORLD RECORD

Distance in a Straight Line (U. S. A.).

Comdr. Thomas D. Davies, Comdr. Eug. P. Rankin, Comdr. W. S. Reid, Lt. Comdr. Ray A. Tabeling — (all U. S. Navy).

Perth (Australia) - Columbus (Ohio).

From September 29th to October 1st, 1946. *18,081.990 km.*

INTERNATIONAL RECORDS, CLASS C

Distance in a Straight Line (U. S. A.).

Comdr. Thomas D. Davies, Comdr. Eug. P. Rankin, Comdr. W. S. Reid, Lt.-Comdr. Ray A. Tabeling — (all U. S. Navy).

With Lockheed P2V-1 monoplane, 2 Wright R-3350 engines of 2,300 H.P. Pierce Field (Perth, Australia) - Port Columbus (Columbus, Ohio).

29th September to 1st October, 1946. *18,081.990 km.*

Speed over a distance of 2,000 km (U. S. A.).

Lt. John J. Hancock (USAAF).

With Lockheed P-80 monoplane, GE-I-40 jet engine.

Wright Field, Dayton, Ohio, on 19th May, 1946. *708.392 km/h.*

Payload : 5,000 kg. Speed over a distance of 1,000 km. (U. S. A.).

Lt. E. M. Grabowski, Pilot ; Lt. J. J. Liset, Co-Pilot ; Crew : M/Sgt. D. P. Kelly, Cpl. O. W. Lambert, Cpl. F. M. Polmotier.

With Boeing B-29 mid-wing monoplane, 4 Wright engines of 2,200 H.P.

Dayton, Ohio, on 17th May, 1946. *594.963 km/h.*

Payload : 5,000 kg.
Speed over a distance of 2,000 km (U. S. A.).

Lt. E. M. Grabowski, Pilot ; Lt. J. J. Liset, Co-Pilot ; Crew : M/Sgt. D. P. Kelly, Cpl. O. W. Lambert, Cpl. F. M. Polmotier.

With Boeing B-29 mid-wing monoplane, 4 Wright engines of 2,200 H.P.

Dayton, Ohio, on 17th May, 1946. *588.456 km/h.*

Under Art. 92 of the Code Général Sportif, Lieutenants E. M. Grabowski and J. J. Liset simultaneously become holders of the following records :

Payload : 2,000 kg. Speed over a distance of 1,000 km (U. S. A.) 594.963 km/h.
Payload : 2,000 kg. Speed over a distance of 2,000 km (U. S. A.) 588.456 km/h.
Payload : 100 kg. Speed over a distance of 2,000 km (U. S. A.) 588.456 km/h.

Payload : 10,000 kg.
Speed over a distance of 5,000 km (U. S. A.).

Lt.-Col. R. G. Ruegg, Pilot ; Lt.-Col. Carl P. Walter, Co-Pilot ; Crew : Lt. J. E. Wetzel, M/Sgt. W. Cunningham and M/Sgt. Hilton — (all USAAF).

With Boeing B-29 mid-wing monoplane, 4 Wright R-3350-23A engines of 2,200 H.P. Dayton, Ohio, on 21st June, 1946. *428.123 km/h.*

Under Art. 92 of the Code Général Sportif, Lieutenants-Colonels Ruegg and Walter simultaneously become holders of the following record :

Payload : 5,000 kg. Speed over a distance of 5,000 km (U. S. A.) 428.123 km/h.

CLASS G — HELICOPTERS

Distance in a Straight Line (U. S. A.).

Major Frank T. Cashman, Pilot ; Major William E. Zins, Co-Pilot — (both USAAF).

With Sikorsky R-54 helicopter, Pratt & Whitney R-985-AN5 engine of 450 H.P. Wright Field, Dayton, Ohio, to Logan Field, Boston, Mass. On 22nd May, 1946. *1,132.337 km.*

Endurance record in a closed circuit (U. S. A.). *9 hrs. 37 min.*

Distance in a closed circuit (U. S. A.). 5,000 km.

Major D. H. Jensen, Pilot ; Major W. C. Dodds, Co-Pilot — (both USAAF).

In a Sikorsky R-5A helicopter, Pratt & Whitney R-985 engine of 450 H.P.

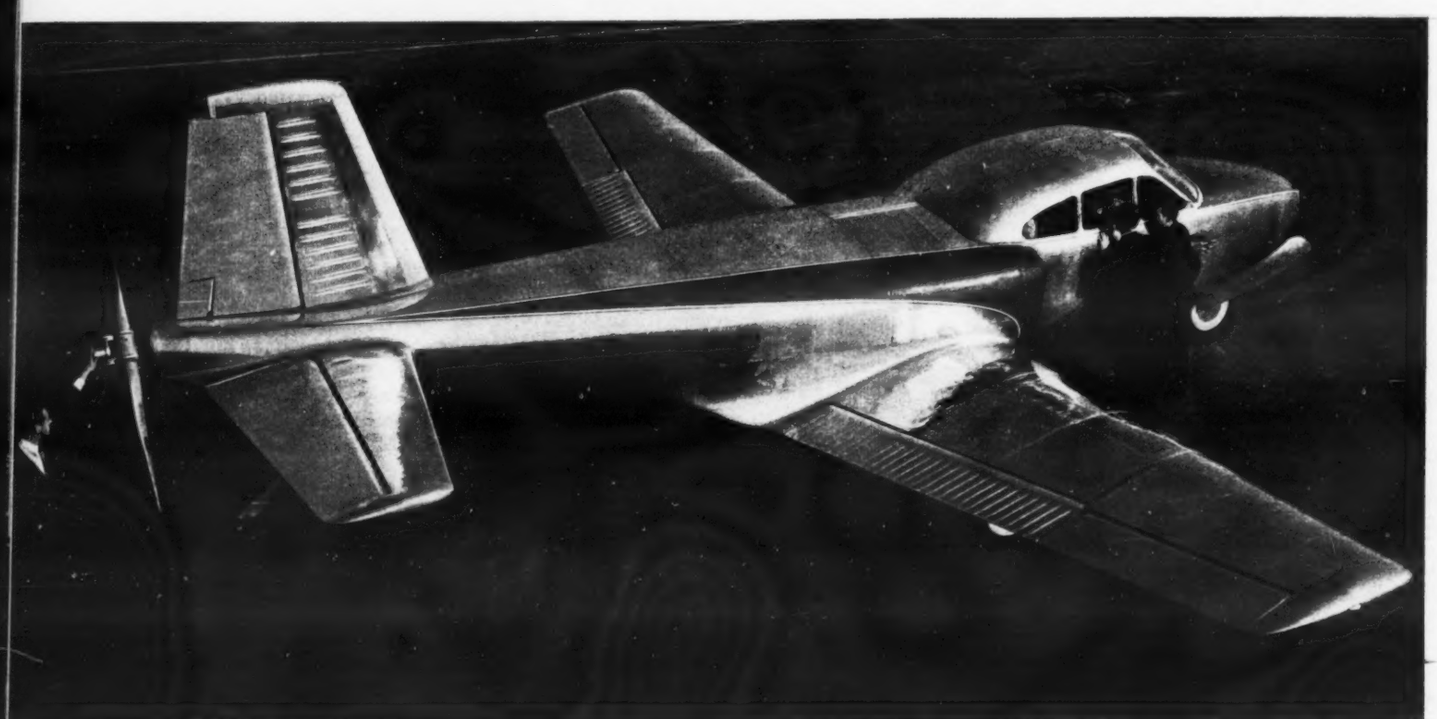
Wright Field, Dayton, Ohio, on 14th November, 1946.

Douglas "Cloudster"

Flash news ! Douglas Aircraft Company, of Santa Monica, known the world over for its multi-engined commercial transports, unexpectedly unveils a small five-seater executive transport, the *Douglas "Cloudster"*.

The constructors of this new aircraft, concerning the development of which strict secrecy was maintained, trod new paths in more ways than one. An all-metal low-wing monoplane, its five-place cabin is situated forward of the wing leading edge. Two independant Continental air-cooled engines, housed in the fuselage, are geared through an extension shaft to a pusher airscrew aft of the tail assembly. Engine cooling air is conducted through lateral channels with intakes against the fuselage walls at leading edge level. The single fin and rudder unit extends downwards to form a fixed vertical fin beneath the fuselage.

There are as yet no plans for production of the *Douglas "Cloudster"*, so that the existing prototype may be regarded as primarily an experimental aircraft built to try out the power arrangement of fuselage-housed engine with rear pusher airscrew. Development will be remembered of the 48-passenger Douglas DC-8 twin-engined transport, featuring a similar arrangement of engines and airscrews (2 contra-rotating tail pushers). A



whole series of other commercial types with rear airscrew or jet drive are also included in Douglas' plans. One recalls the construction of the XB-42 bomber, which crashed at the beginning of last year and has been replaced by the jet-propelled XB-43.

Notwithstanding a relatively high engine output of 500 H.P. for an aircraft of its category, the *Douglas "Cloudster"* is attributed no particularly outstanding performance qualities and could, therefore, very well represent a stop-gap. Its design and engine position give every indication that Douglas is reviewing the question of jet propulsion for light aircraft and already endeavouring to prepare an aircraft suited to the gas turbine and gas turbine-propellor units now in development. Below are characteristics and design performance data concerning this aircraft, which is scheduled to undertake its first trial flights early this year.

Span	39 ft. 9 3/8 in.
Length	35 ft. 4 1/2 in.
Height	12 ft.
Track	15 ft. 3 in.
Airscrew diameter	8 ft.

Payload : 5 occupants and 250 lbs. of luggage.
Power plant : Two Continental air-cooled six-cylinder in-line engines of 250 H.P. each.

Max. cruising speed	200 m. p. h.
Rate of climb on 2 engines at sea level	1500 ft./min.
Rate of climb on 3 engines	600 ft./min.
Ceiling	11,800 ft.
Range at max. cruising speed	950 miles.
Range at max. economic cruising speed	1,100 miles.

Bi.

Publicity!

The Americans are recognised past masters in the art of advertising. Herewith two examples of *new publicity in aviation.*

The *Talking Letter-Box.* — In his characteristic way, "Life's" photographer covers a new campaign launched by the U. S. Post Office. In a busy district of Milwaukee, Wis., an airmail letter-box was adorned with placards and fitted with a loudspeaker inside; and behind a window conveniently near by, a commentator sat at a microphone. Each time a passer-by dropped a letter into the box, he was rewarded with some sort of jocular remark; and if the person happened to be a good-looking young lady — well, as one may imagine, no compliments were spared. — The reason and purpose behind it? Airmail is cheap, a letter only costs 5 cents, so send your letters by air!

Insurance by Slot Machine. — An *Insurograph,* a new machine which delivers up a $ 5000 insurance policy upon insertion of a 25-cent-piece, has been set up at the Airlines Terminal in mid-town New York City by the Associated Aviation Underwriters, the largest U. S. group in the branch. The policy covers indemnity for loss of life, limb or sight as a result of an air crash. Up to five policies may be bought, thus amounting to $ 25 000 of insurance. The machine stamps the date and hour on the policy, whilst the buyer has to write his choice of beneficiary, the time of departure and his destination, and sign it. — The pyschological advantages are manifest: travellers need no longer be shy about holding up fellow passengers at ticket offices; the method eliminates any "admission-of-fear" feeling; it makes it no longer necessary to let the ticket agent know the name of the beneficiary. And, incidentally, business is good: during the first week of operation 400 policies were sold daily, and it is intended to expand the idea throughout the U. S. A.

Book Review *Belgian Air Law*

As in maritime law, Belgium has always played an important rôle in international air law. *M. de Vos,* the Belgian legal expert, was one of the principal drafters of the Warsaw Convention and referenderies at that conference. It was in Brussels that the last diplomatic conference concerning the standardisation of private air law was held, which was brought to a favourable conclusion with the signature of two important agreements.

Hence, it is all the more astonishing to find that Belgian internal air law bases itself on one, highly incomplete law which dates back to 1919 and comprises only 6 articles. A modern law was published in 1937, but has not yet become effective. Swiss air law presents an identical development: pending enactment of new Federal air legislation now before the Federal Assembly, a decision taken by the Federal Council in 1920 still remains valid. In both countries, this obsolete legislation is supplemented by a great number of petty regulations to which add a whole variety of bilateral and multilateral international agreements.

With all this, it has become extremely difficult to determine which part of the law is precisely valid in certain cases. Hence, it is gratifying to learn that the Secretary of the Board of Sabena, *Dr. Max Litvine,* has brought together all laws relative to Belgian aeronautical legislation and all international agreements signed by Belgium (including that of Chicago) into one handbook [1]. This publication also contains a general table indicating all ratifications so far, and an alphabetical index. On the other hand, comments and references to other works are not given. This modest work contains a caustic preface by *Dr. Périer,* Managing Director of Sabena, and a number of introductory remarks by the publisher. It will certainly be of great service to all those interested in Belgian air law.

[1] Max Litvine: *Code du droit aérien belge*; Brussels, 1946. Ferd. Larcier S.A. 143 s., Fr. Belg 175.

Economic Aspects of the American Aviation Industry

(II.)

Since the publication of our last article on this subject (Issue No. 7, October, 1946), there have been no considerable changes in the airline security market on Wall Street ; the *airline group* continued under pressure during the last quarter of 1946, though minor rallying tendencies appeared in December.

The collapse of airline prices in November was largely due to current operational losses already incurred or expected, and more particularly because of the near-term unfavourable outlook which was given considerable publicity by the TWA case. But, as it happens so often, the bearish tendancy lagged behind the actual events and certain conceivable signs of improvement which had arisen during the interval passed unnoticed. Preliminary to discussing the *current position of the airline group,* an analysis of the experience during the first six months of 1946 would appear useful : higher revenues, but even *higher expenses.* The scheduled airline industry showed an aggregate profit of only $ 1,063,000 on total operating revenues of $ 139,298,000. For the same period in 1945, the industry brought down to net profit roughly 10 % of the revenue, as against under 1 % for the first half of 1946. Whereas an operating margin of 23 cents for each revenue mile was shown for 1945, this figure dropped to below 1 cent in 1946.

As part of the *drive to reduce expenses,* a number of airlines reported *substantial lay-offs* in personnel during November, 1946. Continental Airlines has released 120 people, or 12 % of personnel. Western Airlines is laying off 10 % to 15 % of its employees. National, Delta and Mid Continent are envisaging a similar procedure. Pennsylvania-Central has already reduced its payroll about 10 % and plans releasing up to 20 % of its 5,000 employees. TWA has already dropped over 30 % of its 15,000 employees. Even Pan American Airways has shrunk its payroll, though principally in the Atlantic Division. United Air Lines, American Airlines, and Eastern Air Lines are the only carriers which do not contemplate any drastic lay-offs.

Numerous airline companies have *cancelled or curtailed current orders.* TWA has cancelled orders for 10 "Constellations" and 17 Douglas DC-4's. Eastern Airlines wishes to take delivery of only 14 of 20 "Constellations" ordered and, as regards Martin 2-0-2's, to accept 25 but not to exercise an option on a further 25 units. Western Airlines has reduced new plane orders to Douglas Aircraft and Consolidated Vultee by 50 % : accepting only 5 DC-6's instead of 10, and 10 Convair 240's instead of 20. The backlog of the aircraft manufacturing industry has been reduced by an estimated $ 75,000,000 through reduction of airline equipment orders thus far announced or known to be pending.

Opinions of leading aircraft executives as to the *outlook* for the *balance of 1946* and early this year are contradictory. The domestic airlines as a group showed slight profits during 1946, but general opinion is that deficit operations are to be expected during the 1946/47 winter period. The most bearish opinion was held until recently by W. A. Patterson, President of United Air Lines : his company was able to break even with a load factor of 60 % before the war ; today, the break-even point is probably 80 % or above. As, on the other hand, the air travel peak was passed in September and no substantial cost reduction had so far been ascertainable, Patterson fears deficit operations for all the airlines. In the meantime, however, he has become a little more optimistic, as will be seen later.

Other opinions, of a more optimistic nature, are for example held by the presidents of Eastern Airlines, TWA and, most of all, American Airlines. President of the latter, C. R. Smith, finds that a considerable part of the cost of operating an airline comes from the expense of operating ground facilities : considerable economy can only come from more sensible utilisation of joint facilities. *American Airlines' optimism* is also discernible in its new equipment programme : no orders whatsoever curtailed. At present the carrier disposes over 85 Douglas DC-3's and 38 DC-4's. Orders have been placed for 50 DC-6's, 20 four-engined Republic "Rainbows" and 100 Convair 240 twin-engined transports. Except, perhaps, for the "Rainbow's", American Airlines will acquire all these aircraft. Backed by about $ 80,000,000 in working capital and cash reserves, the concern can very well look forward to 1947 with confidence.

The *table* on the following page shows the *earnings* of airline companies during August, September and October for 1946 ; the earnings per share for the first ten months of last year ; *share prices* on October 31st, November 29th and December 30th ; and, finally, the *highest and lowest prices.*

Exaggerated optimism at the beginning of 1946 as to the development of the airline industry gave way at the end of the year to equally exaggerated pessimism. Confidence in the airline industry sank to the point where *the solvency of a number of the larger airlines was questioned.* Certain concerns turned to the Republic Finance Corporation, which is willing, and is obliged to step into the breach if private sources of capital are not available.

However, as mentioned at the beginning, there are *also elements of strength* in the airline industry, which financial circles have lately ignored.

In the first place there is a probability that the Civil Aeronautics Board will not be against an *upward adjustment in passenger fares.* Typical is that the industry is not united on the desirability of increasing fares, although opinion was almost unanimous about a year ago when reductions were demanded.

Further in favour of aviation is the *constant increase in airmail tonnage.* During the last quarter of 1946, an increase of 41 % was visible over that during September, this after the airmail rates had been reduced to 5 cents. Provided that carriers adjust their schedules to require-

	Earnings per share							
	August	September	October	10 Months up to Oct. 31st.	Price Oct. 31st.	Price Nov. 29th.	Price Dec. 30th.	Highest & Lowest prices up to Dec. 31st, 1946
American Airlines	0.1	N.A.	d 0.01	d 0.12	10 5/8	9 1/2	9 5/8	19 7/8— 9
American Overseas Airlines	0.12	0.09	N.A.	0.44 up to Sept. 30th.	11	9 1/2	8 3/8	31— 8
Braniff Airways	0.05	0.01	d 0.02	0	15 3/4	13 1/2	12 5/8	34 5/8—12 1/2
Chicago & Southern	d 0.20	d 0.50	d 0.62	d 2.22	10	8 1/2	7 3/4	20— 7 1/4
Colonial Airlines	0.23	d 0.14	d 0.39	d 1.16	15	11 3/4	11 1/2	43—10 3/4
Continental Air Lines	0.13	0.08	d 0.19 November	0.22 up to Nov. 30th.	9 1/2	8 1/4	8 1/4	26 1/2— 7 3/4
Delta Air Lines	0.12	d 0.07	d 0.20	0.05	28	22	20 1/2	73—20
Eastern Air Lines	0.20 July	0.21 August	0.11 September	1.50 up to Sept. 30th.	22	19 1/4	21	31 1/2—16 1/2
Inland Air Lines	0.19	N.A.	0.01	0.01	8	7 1/8	6	13 1/2— 5
Mid-Continent	0.09	0.11	0.04	0.64	14 1/2	7 1/2	7 5/8	19 1/2— 7
National Airlines	0.13	0.04 October	0.04 November	0.97 November 30th.	17 3/4	16	16 3/4	34 7/8—14 3/4
Northeast Airlines	0.05	d 0.02	d 0.12	d 0.20	9 1/4	7	7 1/4	21 7/8— 6 3/8
Northwest Airlines	0.42	0.26	0.02	1.00	22	20 3/8	20 3/4	56 1/2—18 3/8
Pan American	N.A.	N.A.	N.A.	N.A.	N.A.	12 1/8	12 3/8	27—11 1/2
Pennsylvania-Central	0	d 0.45	N.A.	d 2.20 up to Sept. 30th.	19 7/8	14 1/4	14 3/4	45 3/4—12 5/8
Transcontinental & Western	d 0.34 July	d 1.63	N.A.	d 4.85 up to Sept. 30th.	27 1/4	22	21 1/4	71—18 3/4
United Air Lines	0.34	0.26	0.09	1.37 up to Sept. 30th.	24 7/8	21 7/8	23 5/8	54 1/4—19 1/2
Western Air Lines	0.27	0	N.A.	d 0.50 up to Sept. 30th.	14	10 1/4	9 1/4	35— 7 1/4

d = Deficit. N.A. = Not Available.

ments of the Post Office Department, there is bound to be a further upward trend. The aim is that airmail delivery be made in the first morning mail following posting in all principal cities in the country, and this over distances up to 2,000 miles.

Finally, the *lower break-even point of new equipment on order* may be considered as a *real asset of the airline industry*. Older types now in use have an extremely high break-even point : a Douglas DC-3 requires 93 % occupancy to break even, a Douglas DC-4 only 62 %, and newer models such as the DC-6 will have an estimated break-even point of only 47 %. In any case, these revenues will have to be waited for ; new deliveries will only begin towards the middle of this year and the aircraft will probably not be in full operation before 1948.

* * *

Although the *aircraft industry* was affected by the depression among its clients, the airlines, its *equities* all the same revealed themselves to be *more stable*.

Certain reasonably encouraging earnings reports were released during October. Douglas Aircraft Co. reported a net profit of $ 3,154,000 up to the end of September and declared an added dividend of $ 2.50 per share, making a total distribution to stockholders of $ 7.50 during the year. — Republic Aviation Corp. realised net profits amounting to $ 479,716 during the first nine months of 1946 which, however, were more than absorbed by taxes and other committments so that operations were actually in the red for the nine months' period. The concern had a backlog totalling $ 77,608,000 on September 30th, two thirds of which were military orders. — Northrop reported a small loss for the year up to July 31st, but the backlog of that date amounted to $ 36,618,000, mostly on the B-35 " Flying Wing " and other Government projects. — Lockheed reported that deliveries of commercial and military planes reached a total of $ 114,000,000 in 1946, including 15 " Constellations ", 398 P-80 " Shooting Star " jet fighters and 2 " Neptune " patrol bombers. In spite of fairly successful production results, however, the company will show an operating loss for 1946, despite a backlog of commercial and military airplanes amounting to $ 158,000,000 at the year end. Merger negotiations with Consolidated Vultee may be considered as to have fallen flat. — The Glenn L. Martin Co. counts on profits from deliveries of Martin 2-0-2 and 3-0-3 twin-engined transports, and reported a backlog of $ 196,000,000 already as of September 31st. In addition the company is optimistic about the prospects of its new Marvinol resin product.

Aircraft manufacturing shares were *adversely affected by demands for increased wages and strike threats*. This tendency is strongly entrenched in the Lockheed, Douglas, Consolidated Vultee, Boeing and numerous other West Coast plants ; and on the East Coast the employees of Wright Aeronautical Corp. voted the last week in December in favour of a strike to enforce demands for a 30 % wage increase.

The *table* on the next page shows *prices* for leading aircraft manufacturing equities on October 30th and December 29th, 1946 ; the highest and lowest quotations ; and the net assets per share.

As to the *outlook of the light plane industry*, opinions remain at variance.

Mr. Piper, president of the *Piper Aircraft Co.*, states that the *light plane market has been exhausted*. He said that the backlogs for training type planes had been diminished considerably as a result of the large volume of manufacture of this type since the war, but asserted that orders for family-type three or four-place planes are still being received in quantity. He believes that new models designed for practical transportation will create an unprecedented demand. However, as new airports are being opened each day, the overall utility of aircraft is being increased.

	Price Oct. 31st.	Price Déc. 29th.	Highest and Lowest prices 1946	Net Assets per share
Bell	18 1/2	16 1/4	35 1/2—15 1/2	43.10
Boeing	21 5/8	21 3/8	35 —18	42.00
Consolidated Vultee	18 5/8	16 1/2	35 5/8—14 3/4	37.00
Curtiss-Wright "A"	18 1/2	19 7/8	34 1/4—17 1/8	119.00 a
Curtiss-Wright Common	5 7/8	5 7/8	12 1/8— 5 3/8	16.10 b
Douglas	78	71	108 7/8—63 5/8	109.49
Grumman	30	25	52 1/2—23 1/2	46.75
Lockheed	23	19 3/4	45 1/4—18 7/8	39.65
G. L. Martin	35 1/2	32 3/8	45 1/2—31	43.40
North American	11 1/4	9 7/8	16 5/8— 9 1/4	12.37
Republic	11	9 3/4	24 7/8— 7 7/8	10.22
United Aircraft	19 1/2	18 1/8	37 3/8—16 1/4	32.00 c

a = on a priority basis.
b = Class A & Common combined.
c = After deduction of preferred at call price.

Meanwhile, other *indications in the trade* are less encouraging. The War Assets Administration cut the price of surplus basic training planes from $ 450 to $ 250 each, after they had originally been offered at $ 975.

Another indication of this development : Luscombe Airplane Corp. has laid off approximately 400 of its 1,200 employees and is planning a changeover of production to new types.

It will be seen from the following *table* that three of the concerns mentioned, Globe, Luscombe and *Taylorcraft*, are financially weak. Taylorcraft is *in bankruptcy*, but how a hearing set for January 7th came off, is not yet known.

Let us conclude with a few words on *helicopters.*

Production of helicopters by *Bell Aircraft Co.* is now on an assembly-line basis. Thanks to its versatility, the rotary wing aircraft is being used in agriculture, supervision of high-tension cables, serving fleets, pilot training and, most of all, local airmail deliveries.

The first experimental postal deliveries with helicopters in the Los Angeles, Chicago and New York areas have effectively produced favourable results. A report by a Post Office inspector in charge stated that average mail cargo per trip is less than 300 lbs. for local helicopter delivery, which will permit use of the small Bell two-passenger model at less operating cost than the four-place Sikorsky type. The per-mile cost of flying the Sikorsky model would be 57,4 cents per mile, as against 39,1 cents per mile for the Bell helicopter.

It is interesting to note that several helicopters were taken along by the Byrd Expedition to the Antartic. Exhaustive tests have shown that helicopters are less susceptible to ice formation than ordinary aircraft as the normal vibration of the whirling rotor blades combined with centrifugal force tends to make the thin ice coating fly off as fast as it forms.

December 31st, 1946.

Baker, Weeks & Harden,
Wall Street.
(Jeremy C. Jenks).

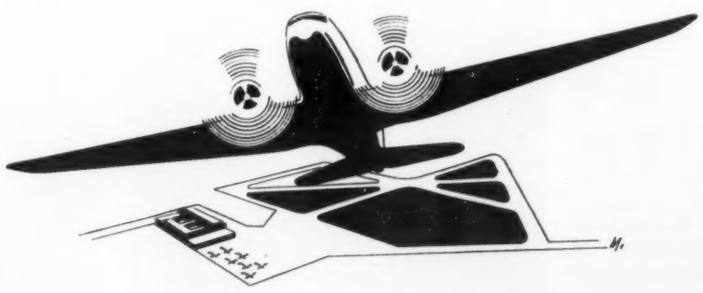
Supplement.

In a year-end statement, *W. A. Patterson,* President of United Air Lines, foresees — in contrast to his earlier, pessimistic attitude — more hopeful prospects for airlines. His company has re-engaged over 1,100 personnel returning from military service and has added thousands of others to bring its pre-war personnel roll of less than 3,500 to nearly 13,000 today. Mr. Patterson declares : "In 1947, the airlines of the country expect to obtain many of the objectives which they have envisioned for the post-war years. New, faster, more luxurious and commodious airplanes plus the elimination of bottlenecks in the ground handling of air traffic should make it possible for us to accommodate the full travel demands. ... We expect to see continued increases in passenger and cargo traffic along with a very substantial gain in airmail ... The worst part of the transition period is over ..."

The Editors.

	Sales in $ 1000			Backlogs in $ 1000		Prices		Highest & Lowest Prices for 1946
	September	October	November	September	October	29th. Nov.	30th. Dec.	
Aeronca	1,601	1,849	1,375	7,895	6,810	7 1/8	6 5/8	15 1/2— 5 3/4
Beech	1,976	1,303	1,297	20,228	16,980	11 7/8	11 1/8	30 7/8—11
Bellanca	176	380	325	1,966	1,706	4	3 1/8	9 1/8— 3
Cessna	1,114	1,485	1,271	1,912	N.A.	4 1/8	4	10 1/8— 4
Globe	800	635	N.A.	18,236	1,920	1	5/8	6 1/8— 3/8
Luscombe	837	460	727	N.A.	N.A.	1 1/8	1 3/8	4 — 1 1/8
Piper	1,301	2,012	1,355	25,858	23,535	5 3/4	5 1/8	15 1/4— 5 1/4
Taylorcraft *	766	N.A.	176	3,420	N.A.	1/8	1/4	4 1/8— 1/8

N.A. = Not Available.
* = in receivership.



THE MONTH IN REVIEW

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POLITICAL

● During the last week of 1946, *Great Britain and the U. S. A. concluded an agreement concerning extensive co-operation between the Royal Air Force and the U. S. Army Air Forces* as regards strategic planning, tactics, equipment, research and training. This agreement, which is part of the general scheme for military collaboration between the two countries, will be put into practice shortly. First of all delegations of about 30 officers of each Air Force will be posted to air bases of the other in order to familiarise themselves with the flying equipment.

● Negotiations are in progress between *Great Britain* and *Chile* concerning British assistance towards the *construction of military airfields in Chile.*

● *Defence Ministries.* Following enactment of the Ministry of Defence Bill on December 20th (Review No. 7), the *British Ministry of Defence* was formally constituted on January 1st. Sir Henry Wilson Smith is Permanent Secretary. — On December 13th all three *Canadian* Defence Departments returned to their pre-war status under a *single Defence Minister,* Brooke Claxton, previously Minister of Health. — In line with the *re-organisation of the Roumanian Cabinet,* the Secretaries of State for War, Navy and Air have been replaced by a single *Secretary of State for Defence Forces,* General Damaceanu. — *The French Government of L. Blum* has amalgamated the former Army and Armaments Ministries into a single Defence Ministry under André le Troquer : Air Force matters come under Delegate Béchart.

● *Germany.* The *four Foreign Ministers,* at their Moscow meeting next March, are to consider a suggestion put to the Russians by the Western Powers that certain *European airlines,* already allowed to operate over Western Germany, be given certain liberties of movement *over all four Zones* of Occupation. — The Soviet Military Authorities decreed that the former *Junkers Flugzeug und Motorenwerke AG.* of Dessau were to be *stripped* by the end of 1946. At the same time the *Inter-Allied Reparations Commission* was arranging for a distribution of equipment from the *Dornier-Werke G. m. b. H.* of Manzell-Friedrichshafen as well as from *Süddeutsche Arguswerke* of Baden-Baden and Hermannsberg-Pfullendorf. — Field-Marshall *Erhard Milch,* long-term director of the Lufthansa prior to his entry into politics as Nazi Under-Secretary for Air, came up before an *American Military Court* on January 2nd.

● *Bilateral Civil Aviation Agreements.* According to an announcement from the U. S. State Department, the U. S. A. has so far concluded civil aviation agreements with 24 countries : Australia, Belgium, Canada, China, Czechoslovakia, Denmark, Egypt, France, Great Britain, Greece, Iceland, Iran, The Lebanon, New Zealand, Norway, Peru, Philippine Republic, Portugal, Saudi Arabia, Spain, Sweden, Switzerland, Turkey and Uruguay. Negotiations for the conclusion of similar agreements are proceeding with Bolivia, Chile, Equador, Haiti, Iraq, Paraguay, Siam, South Africa, Syria and Venezuela. — Discussions to this end are also taking place between *Great Britain and China* and the *U. S. S. R. and Denmark.* — A civil aviation agreement was signed between *France and China* on December 17th.

NEW AIRCRAFT

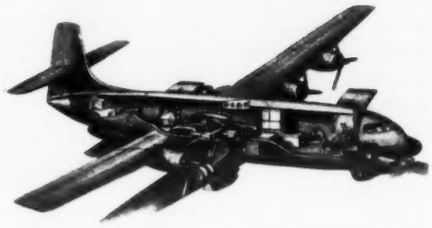
● *Maiden Flights.* The Swedish *Svenska Aeroplan SAAB-90 " Scandia "* twin-engined transport on November 16th, the American *Martin 2-0-2* twin-engined transport on November 22nd, the British *Short " Solent "* four-engined 24-passenger flying-boat on December 1st, the American *Bell XS-1* experimental supersonic rocket aircraft on December 10th and the American *Northrop N. 23 " Pioneer "* three-engined transport on December 21st. Test flights of the British *Saunders-Roe SR/A1* fighter flying-boat and the *Armstrong-Whitworth A. W. 52* tailless experimental aircraft, both fitted with jet engines, are to take place shortly.

Martin 2-0-2

Northrop N-23 " Pioneer "

Armstrong Whitworth A.W. 52

● The French *S. N. C. A. du Sud-Est* is building a 1 : 3 scale flying model of its 140-ton long-range flying-boat, the *SE 1200.*



Curtiss-Wright CW-32

● *Curtiss-Wright Corp.* are constructing a four-engined freighter, the *CW-32,* powered by 1,200-H.P. Wright " Cyclone 9 " engines with exhaust-driven turbo superchargers. Payload, 25,000 lbs. over 1,500 miles ; cargo hold dimensions, 59 × 9 × 7 — 9 ft ; gross weight, 80,000 lbs.

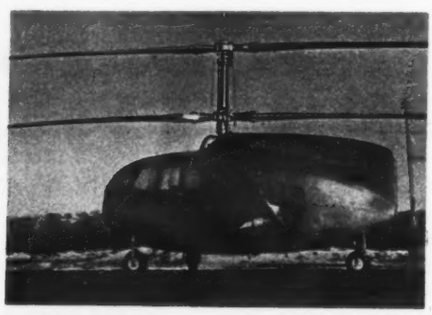
● Details concerning two all-metal low-wing monoplanes being developed by the *Fiat* concern : *Fiat G.218* for 30-36 passengers with Bristol " Hercules 730 " fourteen-cylinder twin-row radials of 1,985 H.P. ; and *Fiat G. 26* for 10 passengers with Alvis " Leonides " nine-cylinder radials of 530 H.P. Max. speed of both, approx. 250 m.p.h.

● Following Lockheed's lead with the " Saturn ", *Boeing Aircraft Co.* has abandoned its *Boeing 417* twin-engined feeder project.

● The *Chance-Vought XF6U-1 " Pirate "* is a new jet fighter developed for the U. S. Navy by United Aircraft Corp. to replace the present " Corsair " carrier-borne fighter : its construction incorporates the use of " Metalite ", a new material made of two thin sheets of aluminium alloy enclosing a balsa wood core. — *Curtiss-Wright* have also built an experimental fighter for the U. S. Navy, the *XF15C-1,* fitted with a Pratt & Whitney radial of about 2,100 H.P. driving a four-blade airscrew in the nose, and an Allis-Chalmers H-13 jet engine beneath the fuselage.

Curtiss-Wright XF 15C-1

● *Bendix Helicopter Inc.* has been engaged for more than a year in experiments with a single-seater helicopter, the *Bendix K,* which has served as a prototype



Bendix J helicopter

* Abridged extracts from Nos. 1243-1258 (Dec. 10th to Jan. 18th) of " INTERAVIA, International Correspondence on Aviation ", an illustrated newsletter published three times weekly in four separate language editions, English, French, Spanish and German.

Bendix K (in flight) helicopter

for a new four-seater, the *Bendix J*, fitted with a Pratt & Whitney "Wasp Junior" radial of 450 H.P. with contra-rotating rotors of 48 ft. in diameter.

INDUSTRY

● The British Air Registration Board has *partially grounded the Vickers* V.C.1. "Viking" twin-engined transport, prohibiting its flying in icing conditions.

● *Packard Motor Car Co.* of Detroit is at present working in collaboration with U. S. Army Air Materiel Command on a new type of *turbo-jet engine for aircraft and missiles*, and is constructing a special turbo-jet laboratory at Toledo, Ohio, which should be ready this spring.

● The Allied Control Commission has authorised the *Breda aircraft works* of Milan to produce six *Breda Zappata BZ 308* four-engined long-range airliners, and *Società Italiana Aeroplani Idrovolanti (SIAI) Marchetti* to build a further fourteen SM. 95 four-engined transports.

● *Major-General Curtis E. LeMay, USAAF Deputy Chief of Staff for Research and Development*, disclosed at Boston University that the plan for the projected *Air Engineering Development Center* will be submitted to Congress in January. The organisation's activities will be directed by representatives from the aircraft industry, National Advisory Committee for Aeronautics, Navy and Army Air Forces.

INDUSTRIAL PERSONALITIES

● The Chief Engineer of *Republic Aviation Corp., Alexander Kartveli*, has been elected to the firm's Board of Directors.

● *D. H. Cunliffe-Owen*, a son of the founder and head of *Cunliffe-Owen Aircraft, Ltd.*, of Southampton, has been appointed to the *Board of Directors* and made *Sales Director*.

● The British radar pioneer, *Sir Robert Watson-Watt*, has given up his post as Scientific Advisor on Telecommunications to the Air Ministry, and formed his own firm of *technical consultants, Sir Robert Watson-Watt & Partners, Ltd.*

● *The de Havilland Aircraft Company's* chief designer, *R. E. Bishop*, who joined the concern in 1921 and contributed to the design of the "Flamingo," "Mosquito," "Hornet," "Vampire," "Dove" and D.H. 108 "Swallow," has been elected to the *Board of Directors*.

● *General Eduardo Barron Sotomayor*, the well-known Spanish pilot and aircraft constructor, has been appointed *Director-General of Flying Equipment, Spanish Air Ministry*.

INTERNATIONAL ORGANISATIONS

● *ICAO : Switzerland* is the 17th State to have ratified the *Permanent Civil Aviation Agreement* of Chicago : ratifications by nine further countries are necessary before the Convention becomes effective.

● *PICAO :* The General Assembly of the United Nations approved in principle an agreement for *liaison between UNO and ICAO*, prepared and submitted by the U. N. Economic and Social Council and the PICAO Interim Council, but stipulated that *ICAO*, when it came into being, should *conform to all U. N. O. decisions as regards Franco Spain*, thus not entertaining any official relations with that State. *As Spain is a Member State of PICAO and has ratified the Permanent Convention*, ICAO will find itself confronted with a difficult problem. — The *North Atlantic Regional Secretariat of PICAO* is to be opened in Dublin on January 18th, with Group Captain E.M. Lewis in charge.

● *IATA :* On December 30th the International Air Transport Association announced the resignation of its *Secretary-General, Dr. Lawrence C. Tombs ;* H. J. Gorecki, Treasurer of IATA, will assume the duties of Acting Secretary-General. — The relations between ICAO and Franco-Spain also represent a problem for IATA, notably as the Spanish carrier, Lineas Aerias Iberia, is one of the founder members of IATA.

AIR TRANSFORMATION

● *North Atlantic Operations :* Bad winter weather over the North Atlantic lead to considerable air traffic disturbances. A large number of scheduled flights were cancelled. On January 3rd, 19 transport aircraft carrying some 700 passengers were held up at Gander, Newfoundland, following the *closing down on January 2nd of La Guardia Field, New York*, due to heavy snow and bad visibility. — *American Overseas Airlines* have extended their trans-Atlantic services to and from New York so as to provide a *Washington-Amsterdam* service with intermediate landings at Gander and Shannon ; a similar *Washington-London-Frankfurt-Berlin* route is to be opened soon. — On January 5th *Pan American Airways* intensified their services to four weekly return trips : two New York-Shannon-Brussels, one New York-Shannon-Prague-Vienna and one New York-Shannon-Frankfurt-Vienna flights. — On January 1st the joint Scandinavian airline group, *Scandinavian Airlines System*, increased their Stockholm-New York service from three to four flights weekly to cope with the considerable traffic demand on the recently-opened Swedish-Russian operated Stockholm-Helsinki-Moscow route. — SAS will shortly open a new service to Montreal and, upon delivery of the Douglas DC-6's, a route to Chicago. — According to the Dutch Ministry of Transport, *KLM Royal Dutch Airlines'* Amsterdam-New York service will be intensified to three trips weekly.

● *South Atlantic Traffic :* The Spanish carrier, *Lineas Aereas Iberia*, has opened a Madrid-Dakar-Villa Cisneros-Natal-Rio de Janeiro-Buenos Aires service ; Douglas DC-4's are flown on a thrice monthly basis. — *KLM* has been flying a service from Amsterdam to Montevideo every Wednesday since January 2nd, with night stops eliminated on the return flight. Services on its South American route are to be intensified to three flights per week, and also to three a week to Curaçao. — *Aerovias Nacionales de Colombia (Avianca)*, the Columbian subsidiary of PAA, made a first survey flight over the Bogota-Rome route at the beginning of last December, but has still come to no decision concerning a scheduled service. — *Scandinavian Airlines System* was able to extend its Stockholm-Montevideo service to Buenos Aires. "Special flights" only will be conducted over the Montevideo-Buenos Aires section during January and February, but as from March 1st, a scheduled weekly return service is projected, whereby a pool operation is under consideration with the Argentine State carrier, *Flota Aerea Mercante Argentina (FAMA)*, and Cruzerio do Sul, the Brazilian airline. Moreover, SAS is planning air cruises to South America in the spring. — *Flota Aerea Mercante Argentina* is to inaugurate an additional South Atlantic service (besides its Buenos-Aires-London route) from Buenos Aires to Cairo via Lisbon and Rome, to be flown with Avro "Yorks" and later "Tudor II's". — On January 10th, Air Vice-Marshal D. C. T. Bennett, General-Manager of *British South American Airways Corp.*, surveyed the Trinidad-Lima (Peru)-Santiago route in an Avro "York."

● *Pacific Traffic :* The British-Australian-New Zealand carrier, *British Commonwealth Pacific Airlines Ltd. (BCPA)*, is to operate six return flights monthly from Australia and two from New Zealand, to Vancouver, Canada, via San Francisco. President of the Company, A. W. Coles, states that authorisation from the United States Civil Aeronautics Administration is being obtained, and that there are some 3,000 would-be passengers awaiting transportation across the Pacific. — At the beginning of January a Douglas DC-4 of *Northwest Airlines* effected the first flight to Tokio via Anchorage, Shemya (Aleutians) and Chitose (Japan), thereby carrying out the carrier's part of the proposed round-the-world air route to be operated in conjunction with TWA. The return to Minneapolis-St. Paul will be made by way of Shanghai and Manila. — *United Air Lines*, who recently received three Douglas DC-6's for a 60-day testing over their routes, announce a San Francisco-Honolulu service with this type of aircraft for April.

● *Africa, Near and Far East :* On January 9th *Trans World Airline* inaugurated the Cairo-Bombay section of their projected round-the-world route to be operated in conjunction with Northwest Airlines. — *KLM* carried out a second Amsterdam-Tunis-Kano-Leopoldville-Johannesburg proving flight and intend to start a regular service in the spring.

● The *U. S. Post Office Department* started *experimental deliveries of airmail by helicopter in the New York district* on January 6th, this after trials in Los Angeles and Chicago had proved so satisfactory that permanent services are envisaged in these areas, to start in February and April, respectively.

● On December 18th the *Swedish Parliament* provided the Transport Ministry with the means to construct an *international flying-boat base at Halmsjön* and to extend Stockholm-Bromma airport. — The *Finnish airfield at Malm*, near Helsinki, has been evacuated by the Russians and returned to the Finns by the Inter-Allied Commission which, however, reserves the right to use it itself.

● *A Ground Organisation Department* (Régie des voies aériennes) has been set up within the *Belgian Ministry of Transport*, the organisation responsible for civil aviation affairs.

● The American-Built bomber base at *Campo Amendola, near Foggia* (Central Italy), is shortly to be sold to the Italian Government and, according to Italian Air Minister Mario Cingolani, is to be converted into a major airport with feeder services radiating to all important cities in Europe. Campo Amendola has runways up to 8,000 ft. long.

● A new runway, 5,250 ft. long and 213 ft. wide, is nearing completion at *Madrid-Barajas Airport :* it will be capable of handling aircraft up to 140 tons *A. U. W.*

● The terms of the peace treaty provide that *Italy* should have *full freedom to expand her internal and international air networks.* Air Minister Mario Cingolani stated at a press conference that apart from the British and U. S. sponsored LAI and AII, *eight Italian carriers will be granted operating certificates,* whereby a number of less promising concerns will have to disappear. — The eight authorised companies are : Società Transadriatica di Navigazione Aerea, Aerea Teseo, S. A. Salpanavi, Aviorimesse Volte Industriali Opere Metalliche S. A. (AVION), Società Italiana Linee Aeree Mediterranee, Avio Linee Italiane (ALI), Società Airone, and a new concern to be formed through merger of the three existing Sicilian carriers.

● *British European Airways Corp.* is to form a *Freight Division* for which 8 Douglas C-47 " Skytrain " (Dakota) cargo transports have been ordered.

● *British Overseas Airways Corp. statistics for 1946 :* route mileage at end of year, 122,798 miles, comprising 63 return services weekly ; 576,500,000 passenger miles ; 150,000 passengers ; 60,000,000 capacity ton-miles. — The Swedish carrier, *A. B. Aerotransport,* flew nearly 4,340,000 miles and carried about 175,000 passengers during 1946, some 100,000 more than in the preceding year. The payroll increased from 1,159 to 2,578 employees. — The Spanish carrier, *Lineas Aereas Iberia,* flew 1,509,000 miles, carried 132,625 passengers in 6,312 flights and transported 8,150 tons of cargo. All these operations were carried out without accident.

● The *McGill University in Montreal* began a course on Civil Aviation on January 1st. Lectures are partly given by resident PICAO and IATA experts.

● *Airline Crashes : December 10th :* A twin-engined Beech 18 " Expeditor " belonging to the Egyptian carrier, Misr Airwork, crashed near Damascus and burnt up. Both members of the crew and the one passenger were killed. *December 23rd :* A Douglas " Dakota " belonging to a British charter company, Atlas Aviation, ran out of fuel and made a forced landing in woodland marshes near Crémieu, whilst flying from Croydon to Geneva ; the aircraft was smashed up causing injuries to the pilot and several of the passengers. — *December 23rd/24th :* An Avro " York " belonging to Flota Aerea Mercante Argentina (FAMA) crashed in thick fog on its first flight over the London-Buenos Aires route just before landing at Rio de Janeiro. The seven-man crew and 13 of the 14 passengers were killed : on the *same night* a Western Airlines transport, carrying a 3-man crew and nine passengers, crashed east of San Diego : all occupants perished. Also on Christmas Eve, three aircraft crashed near Shanghai, two of which belonged to the Chinese National Aviation Corp. (CNAC), and the third to the China Government. Victims totalled about seventy. — On *December 28th* a transport of American Airlines, on the Chicago-Buffalo route, made a crash landing near Michigan City, Ind., resulting in the death of the pilot and co-pilot as well as injuries to more than 20 other occupants. — On *December 28th* a Lockheed " Constellation " of Trans World Airline, on a night flight from Paris to New York, crashed two miles from Shannon and burned out ; 13 out of the 14 passengers and three of the crew of nine were killed. — On *January 5th,* the crash of a transport belonging to China National Aviation Corp. on the Shanghai-Tsingtao run resulted in the death of the three man crew and 29 passengers. The Chinese Transport Ministry suspended the operations of CNAC and another company for a week in order to conduct extensive studies towards radical improvements in navigational equipment. — *January 11th :* a Douglas " Dakota " of BOAC crashed in thick fog on a flight from London to West Africa, resulting in death of 3 passengers and 2 members of the crew. — *January 12th :* an Eastern Airlines transport crashed in a storm near Wythville, Virginia ; according to the sole survivor of 19 occupants, this was due to a fire outbreak prior to an emergency landing.

AIRLINE PERSONALITIES

● On January 8th, *Albert Plesman,* President and General Manager of KLM Royal Dutch Airlines, was awarded the title of *Doctor Honoris Causa* by the Delft University. Born on September 7th, 1889, in The Hague, Mr. Plesman began his flying career as an officer in the Dutch Air Corps. In 1919 he formed the Dutch national airline company on the occasion of the first air exhibition at Amsterdam. Since that time he has been at the head of KLM and its Netherlands East Indies associate, KNILM. During the war KLM was broken up and, for a long time, Plesman was a prisoner of the Germans. Immediately after the war, he reanimated his company. He has been awarded numerous Dutch and foreign distinctions.

Dr. h. c. Albert Plesman, President of KLM Royal Dutch Airlines

● *Gerard d'Erlanger,* Managing Director of British European Airways Corp., has been appointed a Member of the British Air Registration Board.

● *Air Marshal Sir John d'Albiac* has been appointed to the newly created post of Commandant of London Airport (Heathrow).

● *Martin Wronsky,* one-time Manager and Director of the Deutsche Lufthansa, recently died in Berlin after a long illness. Forced into retirement by the Nazis as he was a non-Aryan, Wronsky was one of the principle organisors of German civil aviation.

SERVICE AVIATION

By decree of the President of the U. S. A., the *unified commands of all land, sea and air armed forces* in the various *overseas areas* was re-established on December 16th.

● *Great Britain is delivering flying equipment to the Air Forces of the British Commonwealth.* The *Royal New Zealand Air Force,* whose peace-time strength is to be brought up to five permanent squadrons, is receiving 30 new and 50 overhauled De Havilland " Mosquito VI " twin-engined fighters and the *South African Air Force* has taken delivery of 136 Vickers Supermarine " Spitfire " single-seater fighters.

MILITARY PERSONALITIES

Admiral *Osami Nagano,* former *Chief of the Japanese Admiralty,* who was responsible for *planning the attack on Pearl Harbour* and who was charged as a major war criminal, has *died* in Tokio from tuberculosis.

NOTE FROM THE PUBLISHERS

Our Representation in Great Britain and the U. S. A.

As Wing Commander R. H. Stocken, F. R. Ae. S., M. I. Ae. E., for many years our sole representative for the United Kingdom, was impeded in the execution of his duties by his obligations to the R. A. F., S/Ldr. B. E. de la Torre had temporary charge of our English advertising interests during the past year. Following his demobilisation on December 31st, 1946, **Wing Commander Stocken has once more resumed his post as Interavia's Sole Representative for the United Kingdom,** this since January 1st. Closely associated with our firm for many years, he simultaneously becomes a Member of the Board of Directors. *With this, our business relations with S/Ldr. de la Torre are to be regarded as dissolved. — All enquiries, orders and payments are henceforth to be addressed to W/Cdr. R. H. Stocken, F. R. Ae. S.,* **Interavia London Office, Eagle House, 109, Jermyn Street, London, S. W. 1. Tel : Whitehall 8863.**

On January 1st, 1947, we opened an **Office in New York,** which is responsible for all matters concerning advertising and sales in the U. S. A. Our new **U. S. Representative** is **Thomas B. Stebbings,** who has been known throughout American aviation circles for many years. He assumes charge of our new office at : **292, Madison Avenue, Room 902, New York, N. Y. — Tel : Murray Hill 3 - 7292.**

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